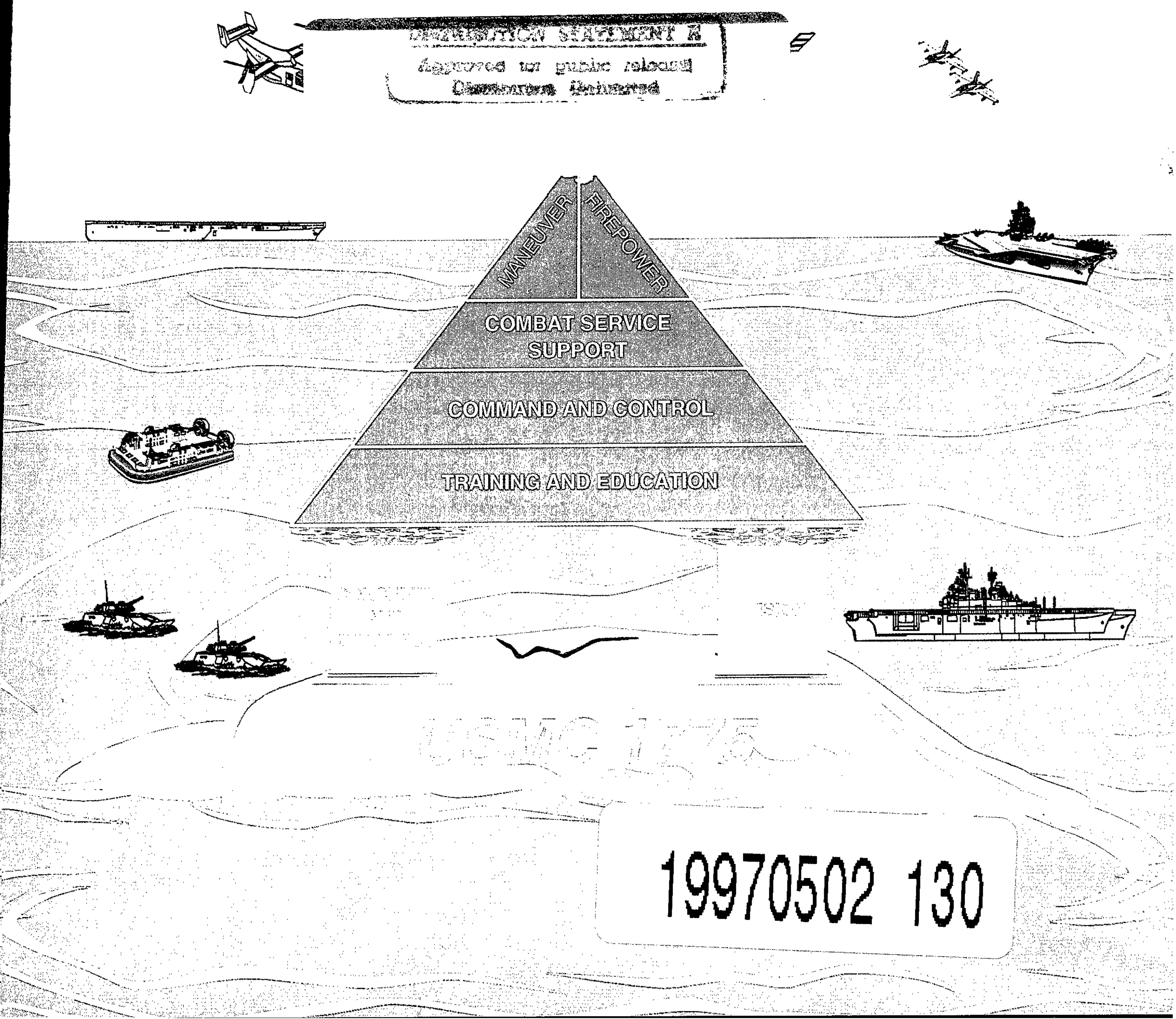
MARINE CORPS APPLIED RESEARCH PROGRAM

FISCAL YEAR 1997 TECHNOLOGY PROGRAM PLAN
PE 62131 M



AQ#M97-06-3945 FY 97 Technology Program Plan PE 62131 M

☐ ________ copies are being forwarded. Indicate whether Statement A, B, C, D, E, F or X applies.

☒ DISTRIBUTION STATEMENT A:
APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

☐ DISTRIBUTION STATEMENT B:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES ONLY; (Indicate Reason and Date). OTHER REQUESTS FOR THIS DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT C:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND THEIR CONTRACTORS; (Indicate Reason and Date). OTHER REQUESTS FOR THIS DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT D:
DISTRIBUTION AUTHORIZED TO DoD AND U.S. DoD CONTRACTORS ONLY; (Indicate Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT E:
DISTRIBUTION AUTHORIZED TO DoD COMPONENTS ONLY; (Indicate Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT F:
FURTHER DISSEMINATION ONLY AS DIRECTED BY (Indicate Controlling DoD Office and Date) or HIGHER DoD AUTHORITY.

☐ DISTRIBUTION STATEMENT X:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND PRIVATE INDIVIDUALS OR ENTERPRISES ELIGIBLE TO OBTAIN EXPORT-CONTROLLED TECHNICAL DATA IN ACCORDANCE WITH DoD DIRECTIVE 5230.25, WITHHOLDING OF UNCLASSIFIED TECHNICAL DATA FROM PUBLIC DISCLOSURE, 6 Nov 1984 (Indicate date of determination). CONTROLLING DoD OFFICE IS (Indicate Controlling DoD Office)

☐ This document was previously forwarded to DTIC on ____________ (date) and the AD number is ________________.

☐ In accordance with provisions of DoD instructions, the document requested is not supplied because:

☐ It will be published at a later date. (Enter approximate date, if known).

☐ Other. (Give Reason)

DTIC QUALITY INSPECTED 4

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly above. Technical Documents must be assigned distribution statements.

Carroll D Childers
Authorized Signature/Date

CARROLL D CHILDERS
Print or Type Name

(703) 784-4789
Telephone Number

MARINE CORPS
APPLIED RESEARCH
PROGRAM

FISCAL YEAR 1997
TECHNOLOGY PROGRAM PLAN
PE 62131M

SUBMITTED:

9 Sept 96

(signature & date)
David A. Vaughn, Director
MARCORSYSCOM (AW)

ENDORSED:

J. E. Rhodes 9 Sep 96

(signature & date)
MajGen J. E. Rhodes
Deputy CG, MCCDC

APPROVED:

(signature & date)
MajGen M. J. Williams
COMMARCORSYSCOM

CONTAINS NO PROPRIETARY INFORMATION

DISTRIBUTION

CMC, ACMC
HQMC (R, PPO)
OPNAV (09, 091, 0911) N8
COMMANDER, MARCORSYSCOM (PAE, TE, AM, SSE, SSC, SST, CBG, C4I2, IC, MCTSSA, C2C, C2A, C2G, C2I, UGV, PS) (32 copies)
CG, MCCDC (C05, C06, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C52) (28 copies)
DIR AWT, MARCORSYSCOM (100 copies)
MARCORSYSCOM Liaison Officers (28 copies)
COMMANDER, CENTCOM (2 copies)
CG, MARFORLANT (2 copies)
CG, MARFORPAC (2 copies)
CG, I MEF (2 copies)
CG, II MEF (2 copies)
CG, III MEF (2 copies)
CG, 1ST MARDIV (2 copies)
CG, 2ND MARDIV (2 copies)
CG, 3RD MARDIV (2 copies)
CG, 4TH MARDIV (2 copies)
CG, 1ST FSSG (2 copies)
CG, 2ND FSSG (2 copies)
CG, 3RD FSSG (2 copies)
CG, 4TH FSSG (2 copies)
DIRECTOR, EXPEDITIONARY WARFARE, OPNAV STAFF (N85) (2copies)
DIRECTOR, JOINT STAFF OPERATIONS (J-3) (2 copies)
DIRECTOR PLANS AND POLICIES, ATLANTIC COMMAND (2 copies)
DEPUTY ASN FOR EXPEDITIONARY FORCE PROGRAMS (2 copies)
DIRECTOR OF OPERATIONS J-3 US CINPAC (2 copies)
ONR 01 (9 copies), ONR OOMC (2 copies), ONR O3 (Code 32) (10 copies)
PDASN (RD&A)
NAVAIRWARCEN (93)
NAVSURWARCEN (Blatstein)
NAVSEA (7 copies)
SPAWAR (313) (3copies)
NAVFAC (03T) (2 copies)
NAVMED (40)
BATTLE COMMAND BATTLE LAB (GORDON) (ATZH-BL) (2 copies)
BATTLE COMMAND BATTLE LAB (LEAVENWORTH) (ATZL-CDC-B) (2 copies)
DEPTH AND SIMULTANEOUS ATTACK BATTLE LAB, CSS (ATSF-CD, ATSF-CBL) (2 copies)
EARLY ENTRY LETHALITY AND SURVIVABILITY BATTLE LAB (ACTD-L) (2 copies)
DISMOUNTED BATTLESPACE BATTLE LAB (ATSH-WC) (2copies)
MOUNTED WARFIGHTING BATTLESPACE LAB (ATZK-MW) (2 copies)
COMBAT SERVICE SUPPORT BATTLE LAB (ATCL-C) (2 copies)
BATTLE FOCUS SUPPORT BATTLE LAB (ATZS-CDT) (2 copies)
BATTLE LAB INTEGRATION AND TECHNOLOGY DIRECTORATE (ATCD-B) (2 copies)
DARPA (TTO) (4 copies)
OFFICE OF THE ASST SEC OF ARMY (RDA) (SARD-TL) (4 copies)
CO, ARDEC (SMCAR-FSA, -F) (4 copies)
CO, NVESD (AMSEL - RD-NV-OD, CM) (2 copies)

DISTRIBUTION (CONT.)

CO, CSSDD (20, 20C (2 copies), 40, 00AL, 30, 340) (8 copies)
CO, ARL, Aberdeen Proving Ground, MD (4 copies)
CO, ARL, Adelphi, MD (4 copies)
CO, NAWC-CL (01T, 01T6, 03A3) (4 copies)
CO, NAWC-PAC (4 copies)
CO, NAWC-TD (4 copies)
CO, NCCOSC (014, 808, 033, 705) (8 copies)
CO, NFESC (L01, L03, L60PMM, MCLNO, L64, L66) (8 copies)
CO, NPRDC (01D) (2 copies)
NSWCCD (6 copies)
NSWCDD (D, B, F, C5, D4, G30, H31) (8 copies)
CO, CRDEC (SMCCR-TD, -TDT, -DDE (2 copies), -PPE (2 copies), OPC, -DDT, -PP)
CO, NRDEC (STRNC -YS, -N, -IFTR) (2 copies)
CNA (George Akst)
Lawrence Livermore National Laboratory (Dr. Milton Finger) (4 copies)
Los Alamos National Laboratory (4 copies)
Sandia National Laboratory (4 copies)
DRPM-AAAV (4 copies)
Marine Corps Research Center

ADDENDUM SHEET

NAME OF SECTION OF WARFIGHTING IMPERATIVE REVISED	DATE OF CHANGE	PAGE NO.(S) AFFECTED	CHANGE ENTERED BY

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

ANNEX

ILLUSTRATIONS

TABLE OF CONTENTS (CONTINUED)

ILLUSTRATIONS (CONTINUED)

THIS PAGE INTENTIONALLY LEFT BLANK.

EXECUTIVE SUMMARY

INTRODUCTION

The Marine Corps, in Title 10, United States Code (USC), is tasked to develop, in conjunction with the Navy, Army, and Air Force, those phases of amphibious operations that pertain to tactics, techniques, and equipment used by the landing force. This Technology Program Plan (TPP) covers a broad range of technology thrusts that will lead to new or improved capabilities in a variety of functional areas that support the landing force. The specific technology efforts respond to the needs determined by the first Marine Corps Science and Technology Expeditionary Warfare Roundtable I, the Commandant's Planning Guidance (CPG), dated 1 July 1995, approved Non-Acquisition Category Program Definition Documents (NAPDDs), and emerging concepts and doctrine.

Amphibious Warfare (AW) is the joint responsibility of the Navy and Marine Corps as defined in the National Security Act of 1947 (amended) and Department of Defense (DoD) Directive 5100.1. Essentially:

a. The Navy provides the shipping, landing craft, and fire support during the initial phase of an amphibious operation.

b. The Marine Corps provides the landing forces and amphibious assault vehicles and assumes the responsibility for its own fire support (aircraft and artillery) once the Landing Force is established ashore.

c. The Marine Corps has the lead for the development of Landing Force doctrine, tactics, techniques, and equipment which are of common interest to the Army or one of the other services.

As good as we are today, we will need to be even better tomorrow. We must not be afraid of reaching outside of the traditional realms of defense acquisition or technology. CPG

Be ever mindful of technological opportunities to enhance combat proficiency and to promote logistic economy. CPG

USMC STRATEGIC CONCEPT

In all that we say and do, we must continually return to the strategic concept that makes the Corps a unique institution within our national military establishment. That concept, articulated by Congress and contained in law in Title 10, USC, reflects our very ethos:

The Marine Corps, within the Department of the Navy, shall be so organized as to include not less than three combat divisions and three air wings, and such other land combat, aviation, and other services as may be organic therein. The Marine Corps shall be organized, trained, and equipped to provide fleet marine forces of combined arms, together with supporting air components, for service with the fleet in the seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign.

In addition, the Marine Corps shall provide detachments and organizations for service on armed vessels of the Navy, shall provide security detachments for the protection of naval property at naval stations and bases, and shall perform such other duties as the President may direct. However, these additional duties may not detract from or interfere with the operations for which the Marine Corps is primarily organized.

The Marine Corps shall develop, in coordination with the Army and the Air Force, those phases of amphibious operations that pertain to the tactics, techniques, and equipment used by landing forces.

The Marine Corps is responsible, in accordance with integrated joint mobilization plans, for the expansion of peacetime components of the Marine Corps to meet the needs of war.

The words of the 82nd Congress, so carefully crafted and articulated nearly 45 years ago, provide us with the foundation we need to move into the 21st century.

"...The nation's shock troops must be the most ready when the nation generally is least ready ... to provide a balanced force in readiness for a naval campaign and, at the same time, a ground and air striking force ready to suppress or contain international disturbances short of large-scale war."

As America's premier force-in-readiness, the Marine Corps must continue to train and equip itself for the challenges of the next century. This confidence is firmly grounded in the Corps' proven track record of being ready through continuous introspection and coordinated investment in emerging technology. Marines play a unique and vital role in our national security. Capabilities inherent in flexible Marine Air-Ground Task Forces (MAGTF) operating as part of naval expeditionary forces, a capability the Marines have continuously refined since the 1930's, are tailor-made for contingencies in today's uncertain world. Additionally, the Marine Corps' institutional qualities of adaptability, innovation, cost consciousness, and tradition of success ensure that the Marine Corps will remain ready, relevant, and capable in the future. Despite unclear security challenges in the new world order, the Marine Corps' well established

"911" role will remain a constant in both crisis response and joint sea-air-land operations with other services in execution of the National Military Strategy. In sum, the Marine Corps will continue to provide a certain force for an uncertain future.

INVESTMENT DETERMINATION AND COORDINATION PROCESS

The Marine Corps System Command's (MARCORSYSCOM) Science and Technology (S&T) Program efforts are completely integrated with the Marine Corps Combat Development Command's (MCCDC) Combat Development Process (CDP) as described in Annex A. Objectives are driven by the Expeditionary Warfare S&T Roundtable process which systematically identifies capability deficiencies and assesses technology that is being, or could be, applied to correct the deficiencies. The S&T Roundtable process is described in Annex B. The overall investment determination and coordination process is completely compatible with the Concept Based Requirements System (CBRS) managed by MCCDC.

MARINE CORPS SCIENCE AND TECHNOLOGY RESPONSIBILITY

Marines have long been known as "innovators" and "improvisers." As part of our ethos, and together with our strategic concept, innovation and improvisation serve as the foundation upon which we will continue to build our institutional objectives and translate them into a vision for the Marine Corps of the 21st century. The basis for that vision must be operational and strategic concepts devised through the CDP and made possible, in many instances, by technological innovation especially selected for the littoral environment and integrated into the battle force holistically, fully compatible, and with an architecture for expansion and adaptability. Responsibility for managing S&T processes and programs within the Marine Corps is vested in MARCORSYSCOM and is delegated to the Director, Amphibious Warfare Technology (AWT) Directorate. AWT executes its responsibility for S&T by directly managing all facets of Small Business Innovation Research (SBIR), Applied Research (6.2), Advanced Technology Development (6.3), and the transition of technology products and programs. Further, AWT coordinates efforts with Program Managers (PM) within MARCORSYSCOM to ensure that successful efforts have funded transition paths. Thus, AWT ensures an end-to-end process such that technology investments are based on approved operational concepts; that they address capability deficiencies; that they reflect a priority articulated by the CG, MCCDC; and, that they are based on a holistic plan that has an executable path to fielding. Figure 1 reflects the management model that accomplishes the integrated S&T planning processes.

CURRENT FOCUS AND ORGANIZATION

The DoD S&T Program consists of Basic Research (6.1), Applied Research (6.2), and Advanced Technology Development (6.3). This plan focuses on Applied Research (6.2). From the S&T Roundtable, the eight Thrust Areas of previous year publications have been consolidated and organized into five Warfighting Imperatives: Maneuver; Firepower; Combat

Service Support (CSS); Command and Control (C2); and, Training and Education. Figure 2 depicts this transformation.

FISCAL SUMMARY

The Fiscal Summary for this 6.2 program is shown in Table 1.

TABLE 1. ADVANCED TECHNOLOGY DEVELOPMENT (6.2) FISCAL SUMMARY FOR FY96-FY01 BY WARFIGHTING IMPERATIVE.

WARFIGHTING IMPERATIVE	FY96	FY97	FY98	FY99	FY00	FY01
Maneuver	7804	4275	4801	5360	5300	5200
Firepower	3000	4186	3600	3900	3800	3600
Combat Service Support	2425	5580	5696	5789	5900	6000
Command and Control	3603	2152	2903	2790	3300	3900
Training and Education	0	900	875	950	1049	1226
Total	16832	17093	17875	18789	19349	19926

6.2 MANAGEMENT

The responsible project management personnel for the 6.2 program are shown in Table 2.

TABLE 2. 6.2 MANAGEMENT PERSONNEL BY WARFIGHTING IMPERATIVE

WARFIGHTING IMPERATIVE	AWT POC	LABORATORY POC
Maneuver	LtCol. W. Hamm 703-784-4790, DSN 278	Mr. M. Gallagher, NSWCDD 301-227-1852, DSN 287
Firepower	Mr. G. Chambers 703-784-4973, DSN 278	Mr. R. Stiegler, NSWCDD 540-653-8141, DSN 249
Combat Service Support	Maj. T. Manley 703-784-4788, DSN 278	Ms. L. Torres, NFESC 805-982-1388, DSN 551
Command and Control	Maj. T. Manley 703-784-4788, DSN 278	Mr. C. Mirabile, NCCOSC 619-553-4161, DSN 553
Training and Education	LtCol. W. Hamm 703-784-4790, DSN 278	Mr. D. Freer, NAWC 407-380-4181, DSN 960

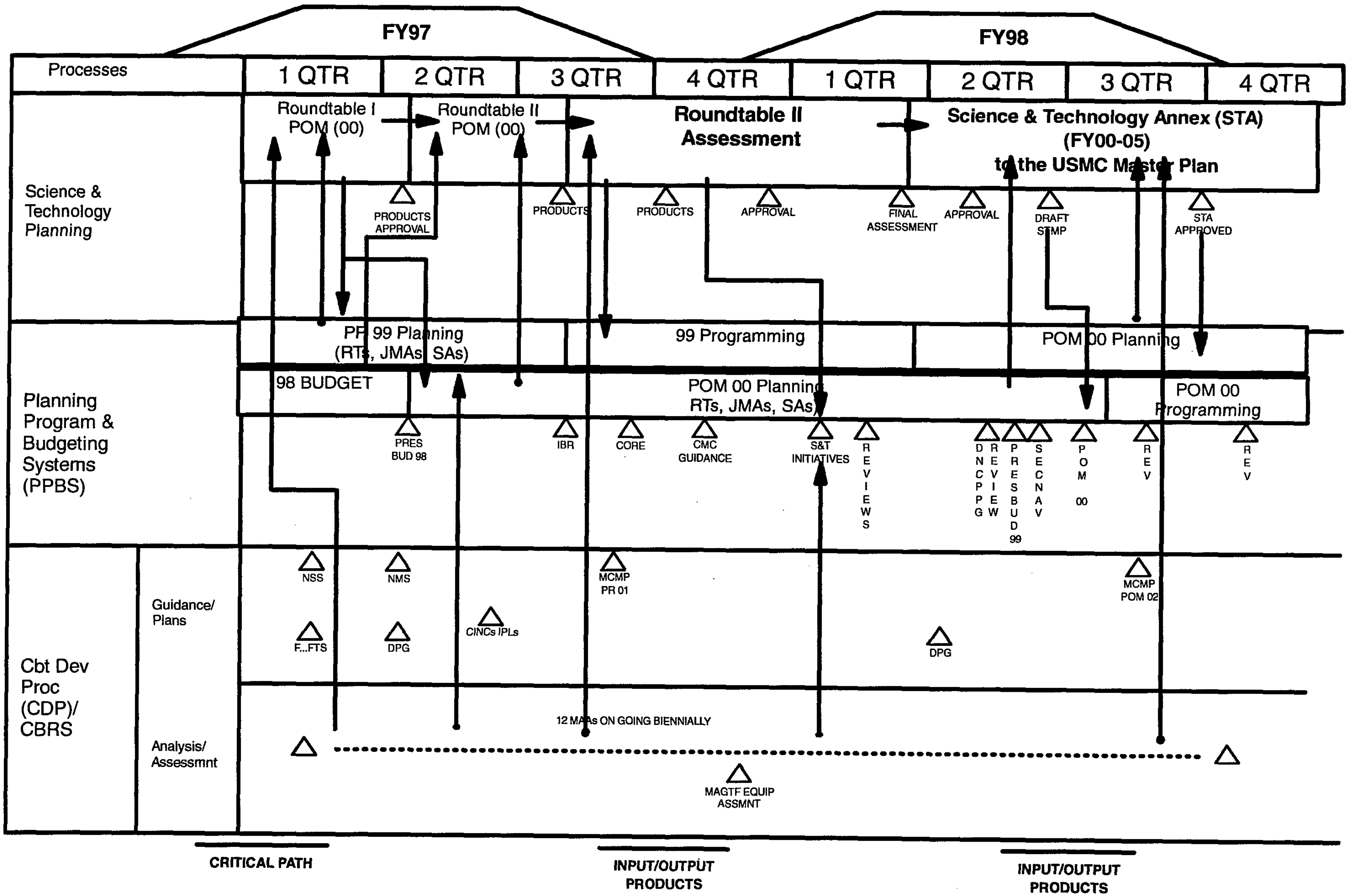


FIGURE 1. INTEGRATED PLANNING PROCESSES

ACRONYMS
FOR
FIGURE 1. INTEGRATED PLANNING PROCESSES

CBRS	CONCEPT BASED REQUIREMENTS SYSTEM
CDP	COMBAT DEVELOPMENT PROCESS
CINC	COMMANDER IN CHIEF
DNCPPG	DEPARTMENT OF NAVY CONSOLIDATED PLANNING AND PROGRAMMING GUIDANCE
DPG	DEFENSE PLANNING GUIDANCE
F..FTS	FORWARD FROM THE SEA
FY	FISCAL YEAR
IBR	INVESTMENT BALANCE REVIEW
JMA	JOINT MISSION AREA
MAA	MISSION AREA ANALYSIS
MAGTF	MARINE AIR-GROUND TASK FORCES
MCMP	MARINE CORPS MASTER PLAN
NMS	NATIONAL MILITARY STRATEGY
NSS	NATIONAL SECURITY STRATEGY
POM	PROGRAM OBJECTIVE MEMORANDUM
PPBS	PLANNING PROGRAM AND BUDGETING SYSTEMS
PR	PROGRAM REVIEW
PRESBUD	PRESIDENTIAL BUDGET
QTR	QUARTER
RT	ROUNDTABLES
S&T	SCIENCE AND TECHNOLOGY
SA	SUPPORT AREA
SECNAV	SECRETARY OF THE NAVY
STA	SCIENCE AND TECHNOLOGY ANNEX
STMP	SCIENCE AND TECHNOLOGY MASTER PLAN

	MANEUVER	FIREPOWER	COMBAT SERVICE SUPPORT	COMMAND AND CONTROL	TRAINING AND EDUCATION
PRE-RT ORGANIZATION OF TECHNOLOGY THRUST	SURFACE MOBILITY SURVIVABILITY MCM MINE DETECTION	TARGETING SENSORS WEAPONRY	ADVANCED AMPHIBIOUS LOGISTICS	MAGTF C4I	
EMERGING AND CURRENT ATDs	FUTURE LIGHT VEH ATD MAGTF SURV ATD JAMC ATD COBRA ATD MCM ACTD RFPI ACTD MOUT/MOBA ACTD	FXXI LW OICW ATD ALGW	ADV AMPHIB LOG/CSS	ICOC ATD JT TAC COM ATD	JT M&S ATD TTES ATD MAGTF INDIV CBT SUP ATD RANGE INSTRUMENTATION

--------A WORK IN PROGRESS--------

FIGURE 2. MARINE CORPS S&T VISION TO ENABLE OMFTS

ACRONYMS
FOR
FIGURE 2. MARINE CORPS S&T VISION TO ENABLE OMFTS

ACTD	ADVANCED CONCEPTS TECHNOLOGY DEMONSTRATION
ADV	ADVANCED
ALGW	ADVANCED LIGHTWEIGHT GROUND WEAPONRY
AMPHIB	AMPHIBIOUS
ATD	ADVANCED TECHNOLOGY DEMONSTRATION
C4I	COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE
CBT	COMBAT
COBRA	COASTAL BATTLEFIELD RECONNAISSANCE AND ANALYSIS
COM	COMMUNICATIONS
CSS	COMBAT SERVICE SUPPORT
FXXI LW	FORCE XXI LAND WARRIOR
ICOC	INTEGRATED COMBAT OPERATIONS CENTER
INDIV	INDIVIDUAL
JAMC	JOINT AMPHIBIOUS MINE COUNTERMEASURES
JT	JOINT
LOG	LOGISTICS
MAGTF	MARINE AIR-GROUND TASK FORCE
MCM	MINE COUNTERMEASURES
MOBA	MILITARY OPERATIONS BUILT-up AREAS
MOUT	MILITARY OPERATIONS IN URBANIZED TERRAIN
M&S	MODELING AND SIMULATION
OICW	OBJECTIVE INDIVIDUAL COMBAT WEAPON
OMFTS	OPERATIONAL MANEUVER FROM THE SEA
RFPI	RAPID FORCE PROJECTION INITIATIVE
RT	ROUNDTABLE
S&T	SCIENCE AND TECHNOLOGY
SUP	SUPPORT
SURV	SURVIVABILITY
TAC	TACTICAL
TTES	TEAM TARGET ENGAGEMENT SIMULATOR
VEH	VEHICLE

INTRODUCTION

WARFIGHTING IMPERATIVES AND SUPPORTING 6.2 PROJECTS

Maneuver

The Roundtable identified **seabase-to-objective maneuver** and **mobility** as specific capabilities required to complete the mission. These two specific capabilities have been consolidated into the single imperative of MANEUVER. Maneuver, by the determination of the Roundtable, requires the supporting functions as shown in Figures B-9 through B-11. The imperative has four (4) main thrust areas for which basic research is being performed: Surface Mobility Technology, Mine Detection Technology, Land Mine Countermeasures Technology, and MAGTF Survivability.

The Surface Mobility Technology effort examines the many challenges Operational Maneuver from the Sea (OMFTS) faces such as maintaining operational tempo, operating over greater stand-off distances, and projecting more power directly to the objective area. In addition, many threats such as shore-to-ship missiles, mines, and direct-fire weapons must be countered or avoided when operating in the littoral area. To overcome these hurdles and successfully execute OMFTS, new technologies must be developed, along with operationally feasible concepts, to meet the system deficiencies which currently exist or are anticipated to exist based on threat analysis and the proliferation of technology world-wide. This effort supports these goals by exploring alternative mobility concepts for the year 2010 and beyond and developing new high risk/high payoff technologies such as electric/hybrid electric vehicle systems, improved mobility components, efficient land and water propulsion systems, predictive mobility analysis tools, and more maintainable and affordable systems.

The Mine Detection Technology effort addresses the urgent and continuing need for the capability of remotely detecting all types of land mines during operations from the surf zone/beach area to inland battlefields. Conventional land mine detection, requiring man-portable detectors and human operators, is slow, presents high risk, and is nonfunctional in the surf zone. The operational deficiency is that no standoff mine detection capability currently exists. The objective then, is to develop and demonstrate technology to provide real-time, day/night detection, and surveillance capability in order to remotely detect current and future mine threats on the battlefield. This capability will provide a unit commander the information required to make timely decisions on assault/maneuver routes and effective deployment of countermeasures, thus, significantly enhancing ground combat unit mobility.

The Land Mine Countermeasures Technology effort focuses on developing and demonstrating technology for rapid neutralization of mines, minefields, booby traps and other obstacles in the surf zone/beach areas to inland battlefields to include advanced threat wide area mines. This effort includes optimization of advanced distributed explosive technologies to attack a wide range of sophisticated and hardened mines by means of destructive projectiles and other

advanced kill mechanisms to attack the main charge and/or sensor package, regardless of fuze type. Validation and testing of distributed explosives characteristics in water and/or on land will be conducted based upon previous modeling efforts. Advanced concepts for mechanical and off route smart mine clearance systems will also be investigated.

The MAGTF Survivability Technology effort strives to increase the survivability of Marine Corps personnel and equipment assets in all levels of combat and physical environments; therefore, preserving valuable assets while maintaining maximum combat power throughout the MAGTF. With a three pronged approach, this effort will develop equipment which will act to deceive state-of-the-art surveillance and target acquisition equipment. Secondly, technologies will be investigated that avoid threat impacts as well as defeat impacts delivered by a hit. Lastly, integrated survivability system suites will be developed for United States Marine Corps (USMC) combat vehicles as well as the management and leveraging of ongoing Special Programs.

Firepower

The Roundtable identified several important capabilities necessary to support functions within the roles and mission of the Marine Corps. These capabilities are specified broadly in order to allow prudent pursuit of technologies that can be developed and applied in a systematic and synergetic manner to accommodate both ongoing, emerging, and joint investments. Capabilities and supporting functions will be developed in two major projects areas supporting the Firepower imperative.

Targeting Sensors Technology focuses on the development of innovative sensor technologies that enhance the engagement performance of direct and indirect fire weapons for the conduct of maneuver warfare by tactical ground commanders. Earliest possible target acquisition, increased first round hit probability, and successful Identification Friend or Foe (IFF) are salient goals.

Weaponry focuses on the development of technologies that increase the lethality, and operational effectiveness of ground combat elements of the MAGTF including new technology for Advanced Lightweight Ground Weapons (ALGW), improving target designation and volumetric lethality against area targets, advanced energetic material for multiple munition use, range, and accuracy.

Combat Service Support

This Warfighting Imperative crosses all the other imperatives and, in fact, shows up in the capabilities and supporting functions diagramed in Figures B-9 through B-11. The imperative has four (4) main task areas for which basic research is being performed to fulfill capabilities: Seabasing Sustainment; Engineering/Supply/Support Services; Logistics C2; and, Transportation, Maintenance, and Corrosion Control Technologies.

The Seabasing Sustainment effort examines areas of logistics operations that are seabased. Specific areas of interest are seabased C2, future scenarios and the driving logistics functions within these scenarios, and the modeling of seabased logistics. Present efforts to seabase concern offload, days of supply, and C2 from a distance proportionate to Operational Maneuver from the Sea doctrine. A technology roadmap for future logistics is defined.

The Engineering/Supply/Support Services effort examines the engineering mission of the future, technologies to support seabased combat service support, and modeling of possible distribution chains for combat service support. This effort addresses both near and far term technologies, as well as mapping technology focus closely with the life cycle of today's capabilities. Bulk liquids, packaging, and aerial resupply are also emphasized focus areas.

Logistics C2 addresses the recent emphasis that with increasing distances of OMFTS and increasing amounts of data, it is necessary to provide tactical logistics C2 with rigor. Focus areas include rapid request system development, Combat Service Support Operations Center (CSSOC) technologies, and commodity planning tools. The goals are to provide intelligent C2 to forward areas, and take full advantage of lessons learned at the Combat Service Support Detachment (CSSD) level.

The Transportation, Maintenance, and Corrosion Control Technologies effort examines those areas of the logistical concept of operations requiring the movement and transfer of material from seabased operations afloat to inland objective areas. Historically, surface sustainment assets have been slow swimming ships/vehicles with limited payload and range. Other drawbacks include non-amphibious operations, poor amphibious ship interface, large footprint, non-organic handling equipment, low budgetary priority, and lack of stealth technology. This effort investigates enhancing and increasing the mobility, range, corrosion prevention, Reliability, Availability, Maintainability-Durability (RAM-D), lift capacity, and self load/unload capability of current and future surface sustainment assets - all at an affordable price.

Command and Control

The C2 Warfighting Imperative is considered by the Roundtable as the overarching imperative that integrates the capabilities of the others. It is also the technology area that is receiving tremendous attention from the other services as well as from key agencies such as the Defense Advanced Research Projects Agency (DARPA). Additionally, this technology receives significant attention by the commercial, education, and industrial sectors, not for "command and control" purposes per se, but for those aspects of mutual interest that are applicable to all such as data base access and manipulation for decision making, inventory control, and autonomous processing.

In accordance with the Roundtable findings, C2 will identify, develop, and transition technology to exploit and enhance the capabilities and supporting requirements as shown in Figures B-9 through B-11.

The objective of the C2 Imperative is to demonstrate the feasibility of inserting emerging electronics, information management, and communications technologies developed by the other services, government agencies, academic, and private sector into systems which support the operational needs of the USMC. In addition, it will identify and investigate technical issues associated with technology transfer and integration into USMC systems and architectures.

To the extent that other organizations are not addressing the capabilities identified by the Roundtable, MARCORSYSCOM will invest an appropriate amount of resources to ensure that we understand and can articulate our needs in the form of requirements and specifications.

Training and Education

The Marine Corps mission necessitates a highly trained force capable of accomplishing an extremely wide variety of tasks in combat and combat support operations. Both initial and follow on training are vitally important. Current training tools are marginally capable of accomplishing the required training and, in some cases, fall short of meeting requirements.

The objective of this imperative is to provide an enhanced training capability for both group and individual skills at all levels from the MEF staff down to the individual Marine. Training will take less time and yield a more qualified trainee.

Specific areas of development will be:

Development of training concepts, which will develop a comprehensive and integrated roadmap for development of future training systems.

Development of automated and intelligent training systems which allow individually paced and tailored instruction, as well as manpower efficiency.

Development of simulation based training for all possible areas to allow experience and evaluation of operational situations and environments previously possible only under limited circumstances.

Integration of training and operational systems to ensure commonality and conservation of resources.

MAJOR ACCOMPLISHMENTS

Maneuver

Within the Surface Mobility technology effort, three (3) new contracts were awarded for the concept and the development of preliminary designs for the Reconnaissance Scout Vehicle

(RSV). The Articulated Electric Drive Trailer (AEDT) was integrated with the Helo Transportable Multi-Mission Platform (HTMMP) and tested to demonstrate improved mobility characteristics for light tactical vehicles. The Joint Tactical Electric Vehicle (JTEV) project completed contractor acceptance testing and started the incorporation of advanced technology components in cooperation with DARPA. Fabrication of the Advanced Propulsion System (APS), an electric land and water drive amphibious vehicle, was completed and testing initiated.

Under the Mine Detection Technology effort, a contract was let to the Xybion Corporation for a Tunable Filter Multi-spectral Camera (TFMC). This will be a multi-barrel camera with coverage of the visible and near infrared (IR) wavelength bands, with growth room for a mid-range IR channel. Liquid crystal tunable filters will be used for instantaneous electronic adjustment of the center wavelengths for optimum detection of any mine type. Data will be recorded during the 6.2 phase. Preliminary camera design was completed in Fiscal Year (FY)96. The Automatic Target Recognition (ATR) algorithm suites developed by combining the work of several contractors in a version giving optimum performance has been tested for speed of execution, looking to real-time hardware implementation. An algorithm technique for proper tuning of the TFMC has been developed. Coastal Battlefield Reconnaissance and Analysis (COBRA) data link options for near real time imagery have been assessed and a near real time image processor has been developed at MITRE. Operational modeling of the COBRA system has been undertaken using the Army's Modular Semi-Automated Forces (MODSAF) model at MITRE. The model has also been implemented at CSS. Development of an advanced diode array for TFMC self-illumination has been initiated at the Lawrence Livermore National Laboratory (LLNL). Technology for passive millimeter wave imaging has been assessed. Experiments conducted during this effort showed that mines can be imaged under fresh snow and ice, as well as at night and through fog.

Accomplishments directed through the Land Mine Countermeasures Technology effort for FY96 include the completion of the jet/overburden/mine interaction analytical model and the evaluation of alternative explosives on charge performance. An improved anti-mine munition concept for future systems was successfully transitioned. Development of a surrogate threat Anti-Helo Mine (AHM) Countermeasure sensor platform was completed along with the identification and ranking of possible AHM countermeasure techniques. Extensive modeling and analysis of baseline vehicle blast and structural interaction was completed as well as computer modeling of physiological effects of land mine detonation to evaluate effects on human lungs/heart. Transitioned the design of mine protection blast deflectors to Army Tank and Automotive Command (TACOM). Four (4) contracts were awarded to participate in the initial phase of the Mine Hunter-Killer project where proof-of-concept demonstrations were demonstrated.

The MAGTF Survivability Technology accomplishments for FY96 include the demonstration of tactical decal technologies that alter signature characteristics in the visual and thermal spectrum on the Propulsion System Demonstrator (PSD) vehicle. Also, a joint classified effort with US Army, which is applicable to USMC vehicles, continued throughout the fiscal year. An advanced Ceramic-metal (CERMET) material effort for armor application was completed with mixed results. Testing of ceramics on composites and aluminum materials for

evaluation as structural armor systems continued. A conceptual study of an advanced armor applied to a USMC vehicle was conducted with promising results for defeat of top attack threats. The effort transitioned into an Army program for further design of a USMC application.

Firepower

Within the targeting sensors effort, FY96 accomplishments include the establishment of the USMC Technology Evaluation Assessment Modeling and Simulation (TEAMS) facility at Naval Surface Warfare Center, Dahlgren Division (NSWCDD), Dahlgren, VA. The facility is being utilized for the development and assessment of real-time targeting sensor technologies to provide organic capability to the maneuver elements. The facility will be networked with Fort A.P. Hill, VA; Marine Corps Base (MCB) Quantico, VA; Naval Command and Control and Ocean Surveillance Center (NCCOSC) Research, Development, Test, and Evaluation (RDT&E) Division (NRAD), San Diego, CA; Marine Corps Tactical Systems Support Activity (MCTSSA), Camp Pendleton, CA; and Coastal Systems Station (CSS), Panama City, FL. The facility and ranges will be the primary sites for feasibility analysis of tactical weapons/sensor integrated systems.

The final test/evaluation of the gun launched Expendable Acoustic Remote Sensor Systems (EARS) was performed at Fort A.P. Hill. A final technical report with an associated video tape has been published.

Over $6 Million in contracts have been let via the targeting sensors Broad Agency Announcement (BAA) N00178-96-Q-1002.

Within the weaponry effort, the Battlefield Marker Panel (BMP) has transitioned through the Army. The Marker panels provide a lightweight, highly portable, day night complimentary system to the VS-17 panels.

The 120mm auto loader system has been demonstrated under the mobile automated Fire Support System Task. Complete drawing packages are available to further development and incorporation into turrets 120 mm systems.

Initial evaluations of new breaching chemically/explosives have demonstrated the feasibility of successfully breaching reinforced concrete obstacles with light-weight weapons.

Combat Service Support

Within the Seabasing Technologies effort, FY96 accomplishments include the establishment of a Naval Integrated Product Team to coordinate seabasing interests across a variety of technology focus groups. This task also outlined the technology roadmap for logistics, expanding the scope of the project significantly to include C2 and transportation needs. Other

technology focus areas such as seabased C2 and seabase modeling are new starts, resulting from the technology roadmap.

Engineering, Supply, and Services has yielded a prototype meteorological hydrogen generator which greatly reduces the footprint of this system on the battlefield. A prototype container handler has been developed providing mobility to International Standards Organization (ISO) containers while staying within the envelope of air lift requirements. Innovative materials for packaging and bulk fuel transportation and storage have been investigated. A model for analyzing distribution networks in support of various concepts of operation has been developed, and synthesis and analysis continue.

The Logistics C2 effort is a new start in FY97.

Within the Transportation, Maintenance, and Corrosion Control Technologies effort, FY96 accomplishments include the development of advanced vehicle concepts for the Expeditionary Logistics Transporter (ELT). As a result of a BAA solicitation, a total of four (4) concepts are being developed by four (4) different contractors who are addressing the spectrum of known operational functions and missions. Through modeling and simulation assessment tools, these concepts are being evaluated to provide maximum payoff in operational utility and effectiveness.

In addition, accomplishments in the CPAC effort include expanding the marine atmosphere exposure test matrix to include additional technologies and treatments such as inorganic coatings for sheet metals, exhaust systems and new alternative materials for various vehicle components. Also, accelerated test procedures have been initiated to determine applicability to predicting corrosion performance in typical USMC operating environments. Plans for field testing heat resistant coatings to combat high temperature corrosion problems have also been initiated.

Command and Control

The prototype systems developed by Amphibious Assault Planner (AAP), Korean-English Language Translator (KELT), and Course of Action (COA) were transitioned to the MCTSSA to determine potentials for early fielding into the MAGTF Command, Control, Communications, Computers and Intelligence (C4I) architecture. Technical and user evaluations were conducted by MCTSSA with the respective projects providing the necessary technical support. Phase II contracts for the Over the Horizon (OTH) non-satellite communications project was put on hold and the task for FY96 was revised to investigate related communications technologies to meet near-term joint requirements. The OTH task to investigate technology tradeoffs between trunkline and networked applications for OTH relays is being continued. Several new efforts were initiated in FY96. Commander's Critical Information Requirements (CCIR) is a decision aid that uses text search technology to automatically match incoming messages to CCIRs. Two new starts initiated support the intelligence mission area for C4I. Radio Reconnaissance Technology investigated the capability for a handheld device that has the

ability to locate sources of Radio Frequency (RF) energy for use in the year 2000 and beyond. The Digital Imagery task for FY96 conducted a technology survey of image compression technologies to support the USMC Secondary Imagery Dissemination System (SIDS).

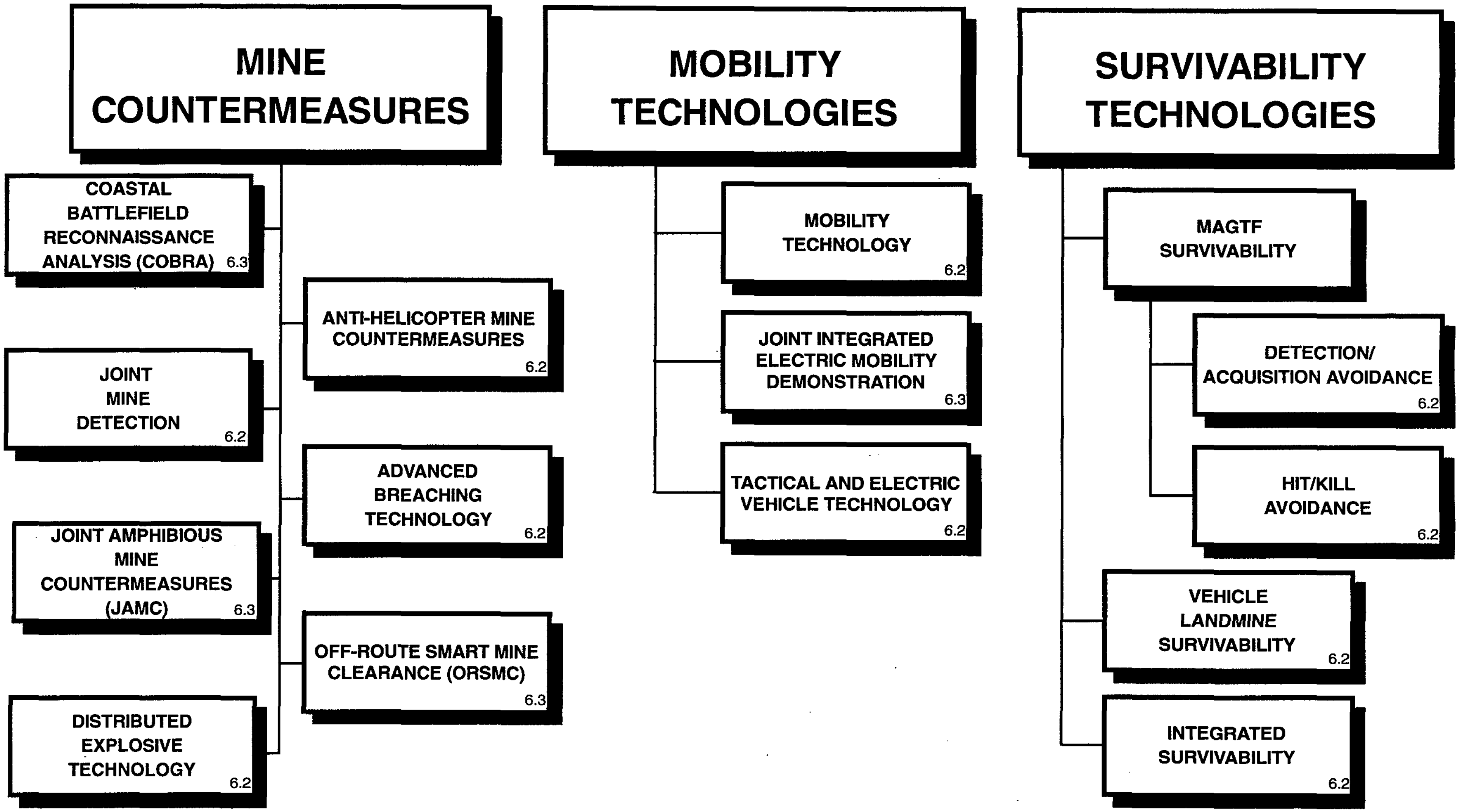
Training and Education

The Training and Education effort is a new start in FY97.

FY97 TASKS

THIS PAGE INTENTIONALLY LEFT BLANK.

MANEUVER IMPERATIVE



NOTE: SEE 6.3 PLAN FOR ALL 6.3 PROJECTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

Imperative Title: MANEUVER

THIS PAGE INTENTIONALLY LEFT BLANK.

MANEUVER IMPERATIVE

PRINCIPAL OBJECTIVE AND TECHNICAL THRUSTS

The primary objective of the Maneuver Imperative is to demonstrate the feasibility of advanced technologies which increase the effectiveness of the Marine Corps in performing their designated missions. These capabilities can be characterized as improvements in tactical mobility, mine detection, landmine countermeasures, and survivability. Improvements in mobility include: maneuverability; speed; range; payload RAM-D; and, affordability. Improvements in mine detection include anti-vehicular and anti-personnel mines on the beach and on land. Improvements in landmine countermeasures include effective countermine capabilities during amphibious operations and subsequent operations ashore against future mine warfare threats. Improvements in survivability include detection acquisition avoidance, hit/kill avoidance, and integrated survivability/special programs.

STRUCTURE AND TASK IDENTIFICATION INCLUDING OUTYEAR NEW STARTS

The Maneuver Imperative project includes ten individual tasks to accomplish FY97 technology objectives. These cover the spectrum of Marine Corps surface assets as well as addressing system supportability and affordability issues.

Mobility Technology

The goals of the emerging OMFTS concept are to seamlessly project combat power ashore, apply maneuver warfare in littoral and inland areas to rapidly attain mission objectives, and sustain land forces once these objectives are met. This task supports these goals by exploring alternative vehicle concepts and new components and subsystems for USMC vehicles for the year 2010 and beyond. Attaining these goals requires the exploration of many high risk/high payoff technologies on a component, subsystem, and system basis. These technologies include, but are not limited to: improved mobility systems, efficient land and water propulsion systems, and more sustainable and affordable systems. Projects within this task involve the development of both the vehicle platforms and the subsystems required to achieve OMFTS goals. Initial vehicle concepts are generated that address envisioned mission functional requirements derived from OMFTS and similar documents. These vehicle concepts are analyzed for their overall ability to successfully and effectively perform future missions. Modeling and Simulation (M&S) tools, either unique for the USMC or adopted from Navy and Army tool sets, are utilized to develop, assess, and evaluate operational suitability. Those concepts found to be superior are further defined and detailed to identify the individual technology initiatives required to successfully realize the system level performance. A technology roadmap has been constructed

and is regularly updated to guide the development of these key technologies and provides direction for this task.

Tactical and Electric Vehicle Technology (TEVT)

This task focuses on the development and demonstration of advanced electric and hybrid electric technologies for tactical and combat vehicles used for transport, reconnaissance, light weapons platforms, and related mission variants. Emphasis is placed on USMC unique or joint service wheeled vehicles and on improving the mobility of these tactical vehicles with regard to their differing mission requirements. New vehicle platforms and improved subsystems, including electric and hybrid electric propulsion to improve mission performance will be developed.

Joint Mine Detection Technology

This task focuses on the development of improved sensor technologies. Cooperation is sought where possible with related efforts by the Army, Air Force, or DARPA.

Distributed Explosive Technology (DET)

Develop the land, surf zone, and general mine countermeasures technologies that will defeat all present and future mine threats encountered regardless of type, fuzing, or hardening. The use of this technology in future system development efforts will significantly increase the US Marine Corps' combat capabilities in neutralizing mine threats during the assault phase and rapid follow-on clearance operations.

Anti-Helicopter Mine Countermeasures (AHMCM) (formerly named Off-Route Smart Mine Clearance (ORSMC))

Develop a countermeasure system that will neutralize advanced, electronically smart mines capable of autonomously detecting, classifying, and targeting slow moving, low flying aircraft. These mines can not be countered by existing aircraft protection systems. Countermeasures techniques include acoustic/seismic signature reproduction and IR/millimeter wave (MMW) signature suppression technologies that initiate the mine system but evade the kill mechanisms of these smart mines.

Vehicle Landmine Survivability (VLS)

Develop technologies that will sustain combat power by enhancing the survivability of personnel, vehicles, and equipment in a landmine intensive environment.

Advanced Breaching Technologies (ABT) (formerly named Mine Countermeasures Integration and Automation (MCMIA))

This task will focus on development of technologies capable of breaching minefields to provide the MAGTF enhanced in-stride breaching, wide area/rapid follow-on clearance, and expedient supply route clearance. Technology development and technology transition will be based on emerging OMFTS doctrine.

Detection/Acquisition Avoidance Technologies

The objective of this task is to develop equipment which will act to deceive state-of-the-art surveillance and target acquisition equipment. This task will develop lightweight, affordable, and advanced camouflage systems for application to USMC vehicles and their crew. The marine environment provides a unique challenge in applying lightweight applique systems to assault and tactical support vehicles. The appliques need to survive the saltwater environment. This task will involve joint participation with the Army as well as leveraging of Army and DARPA programs.

Hit/Kill Avoidance Technologies

This task addresses technologies to avoid threat impacts as well as defeat impacts given a hit. Such technologies include advanced armor systems as well as electronic countermeasure systems for both future and existing USMC equipment. It will provide technical oversight and coordination for potential joint USMC/Army programs. In addition, this task will keep aware of potential new and innovative materials and systems as they become available for exploration.

Integrated Survivability/Special Programs

The objective of this task is to develop integrated survivability system suites for USMC combat vehicles as well as manage ongoing special programs. This task will capitalize on the developments accomplished under the previous two tasks. The integrated survivability approach requires that the threat for the particular vehicle of interest be defined and that a survivability suite be designed based on the operational impacts to the vehicle and the trade-offs involved regarding weight, power, cost, and overall pay-off.

THIS PAGE INTENTIONALLY LEFT BLANK.

MANEUVER IMPERATIVE FUNDING ($K)

TASK NO.	PERFORMER	FY96 CURRENT FY	FY97 EXECUTION FY	FY98 BUDGET FY	FY99 BY+1 FY	FY00 BY+2 FY
1	NSWC/CD	310	475	750	775	875
	WES	0	0	200	0	0
	CONTRACTOR	1249	100	550	1585	1425
2	NSWC/CD	325	285	200	200	200
	CONTRACTOR	300	160	400	300	300
3	NSWC/DD-CSS	504	500	661	400	400
	CECOM	322	0	0	0	0
	PAX RIVER	0	0	0	0	0
	CONTRACTOR	1174	930	640	700	600
4	NSWC/IH	915	250	0	0	0
	CONTRACTOR	285	250	0	0	0
5	NVESD	200	0	0	0	0
	CONTRACTOR	0	0	0	0	0
6	NVESD	300	100	0	0	0
	CONTRACTOR	0	0	0	0	0
7	EODTECHCEN	500	0	500	500	300
	NSWC/IH	0	0	200	200	500
	CONTRACTOR	0	0	0	0	0
8	NSWC/CD	166	25	100	100	100
	CONTRACTOR	95	0	150	150	150
9	NSWC/CD	83	25	100	100	100
	CONTRACTOR	115	0	100	100	100
10	NSWC/CD	544	50	100	100	100
	CONTRACTOR	417	1125	150	150	150
PROJECT TOTALS		7804	4275	4801	5360	5300

TASK NO.	TITLE
1	MOBILITY TECHNOLOGY
2	TACTICAL AND ELECTRIC VEHICLE TECHNOLOGY
3	JOINT MINE DETECTION TECHNOLOGY
4	DISTRIBUTED EXPLOSIVE TECHNOLOGY
5	ANTI-HELICOPTER MINE COUNTERMEASURES
6	VEHICLE LANDMINE SURVIVABILITY
7	ADVANCED BREACHING TECHNOLOGIES
8	DETECTION/ACQUISITION AVOIDANCE TECHNOLOGIES
9	HIT/KILL AVOIDANCE TECHNOLOGIES
10	INTEGRATED SURVIVABILITY/ SPECIAL PROGRAMS

IMPERATIVE: MANEUVER

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. MOBILITY TECHNOLOGY														
A. Advanced Vehicle Concept Development														
(1) Program Plan/Roadmap (1)	R		O				O (2)	R				R	R	R
(2) Concept Development		C			T (Logistics Imperative)									
B. BAA Solicitation														
(1) Award of Selected Proposals				C	S		C					S	C	
C. Mobility Technology Development														
(1) Analysis					S			C				S	C	
(2) Preliminary Design							S			CR				
(3) Test/Demonstration													S	CR

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:
1. Integration and evaluation
2. In-process Review

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. TACTICAL AND ELECTRIC VEHICLE TECHNOLOGY (TEVT)														
A. Articulated Electric Drive Trailer (AEDT)														
(1) Fabricate			C											
(2) Acceptance Test/Demonstration		S	D		CR									
(3) Government Test							S			C				
B. Joint Tactical Electric Vehicle														
(1) Fabricate	C													
(2) Acceptance Test		S	D	C	R									
(3) Government Test/Demonstration					S		C	S			C			
C. Advanced Propulsion System (APS)														
(1) Fabrication/Modification/Integration				C										
(2) Acceptance Test/Demo					S		CR							
D. Electric Technology BAA			C								S		C	

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. JOINT MINE DETECTION TECHNOLOGY														
A. Investigate Coherent Detection for Elimination of Image Blurring due to In-water Forward Scattering									S(1)				C	
B. Award Contract, Fabricate, and Demo Visible near IR Tunable Camera after Design Approval			S					H	D	C				
C. Assess Passive Millimeter Wave Technology Using Existing Devices in Cooperation with the Airframe and DARPA	S			C										
D. Investigate Technologies to Extend Detection Range/Buried/Underwater Mines						S(2)							C	
E. Investigate Passive Millimeter Wave Images for Mine Detection						S						C		
F. Develop Fixed-but-Multiple Wavelength Laser via Effort at LLNL, for Mounting with Tunable Filter Multispectral Camera	S								H	D C				
G. Initiate 6.3A ATD					S								CDR(3)	
H. Extend ATR Algorithm and Image Synthesis Tool to UV and Near IR						S(4)						C(4)		
I. Integrate/Demonstrate Multi-wavelength Laser with Tunable Filter Multispectral Camera											S		D C	
J. Fabricate/Demo Technologies for Extended Detection Range/Buried Underwater Mines													S(5)	
K. Develop IR Channel for Tunable Multispectral Camera									S				C	

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Restart
2. Long term effort
3. For demo of tunable camera
4. Unfunded
5. Initiate as appropriate

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 4. DISTRIBUTED EXPLOSIVE TECHNOLOGY														
A. Precision Initiation					RCT (PE63612M)									
B. Effect of Liner Manufacturing Process	<u>S</u>						RCT (PE63612M)							
C. Numerical Simulation	<u>S</u>							RCT (PE63612M)						
D. Effect of Accuracy and Precision	<u>S</u>							RCT----------					----------RCT (PE63612M)	
E. Array Initiation					S						RCT (PE63612M)			
F. Array Configuration						S					C----------		----------C	

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 5. ANTI-HELICOPTER MINE CM														
A. Threat Characterization and Countermeasures Concepts Definition		C----	----	----	----	----	----	----C						
B. Define Surrogate Mine Requirements & Develop Surrogate Mine Platform												H----	----	----
C. Countermeasure Breadboard Development		S----	----H----	----	----	----	----	----	----S----	----	----H	RC----	----	----
D. Test/Analysis of Key CM Concepts		S----	----	----	----	----	----	----	----S				RC----	----
E. Predictive Modeling		S											RC----	----
F. Demonstration Coordination					S					C----	----	----	----	----
G. Countermeasures Demonstration											D----	----	----	----
H. Transition Coordination							S						C----	----
I. Transition												T	(PE63640M)----	----
J. Next Generation Threat Characterization & CM Concepts Definition										S				
K. Next Generation CM Development													S	

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 6. VEHICLE LANDMINE SURVIVABILITY														
A. Deficiencies/Requirements Analysis	----	----	----	----	---R									
B. Baseline Testing of Structural Blast Effect on Trucks	-R---	----	---C---	----	R									
C. Baseline Analysis/Model of Physiological Effects	----	----	---C---	----	CR									
D. Baseline Model Verification Testing	-C---	R---	R---	----	C---	---R								
E. Follow-on Design, Modeling and Testing			C---	---R	----	---C---	----	----	-R					
F. System Demonstration					D---	----	D							
G. Transition Documentation/Report				S				RC						
H. Transition							T---	----	----	---T				

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 7. ADVANCED BREACHING TECHNOLOGY														
A. Mine Hunter-Killer														
(1) Technology Assessment		CR			S			CR						
(2) Threat and Operational Assessment						S		CR						
(3) Controller Development	S							CHR						
(4) Model Based Simulation Development	S				H				C					
(5) Test Bed Development and Testing			S						CR					
(6) Test Bed Demonstration					S				CR					
(7) Warhead Development			S									CHR------	----------	----------
(8) Sensor Development				S									CHR------	----------
(9) System Demonstration & Transition												S------	------S CDRT------	----------
B. Advanced Vehicle Breaching Technology														
(1) Technology Feasibility Study									S				CR	
(2) Modeling & Simulation													S	CR

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 8. DETECTION/ACQUISITION AVOIDANCE TECHNOLOGIES														
A. Multi-Spectral Camouflage Appliques	C	R H T (PE63640M)												
B. Joint Army/USMC Advanced Signature Management and Deception														
(1) Broad Agency Announcement							S	C						
(2) Develop Advanced IR Coatings/Appliques/Structures									S				C	
(3) Develop Hybrid Signature Management Systems (SMS)									S					C
(4) Develop Multi-Spectral SMS												S		C

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS) 1	2	3	4	FY97 EXECUTION YEAR (QUARTERS) 1	2	3	4	FY98 BUDGET YEAR (QUARTERS) 1	2	3	4	FY99 (BY+1)	FY00 (BY+2)
TASK 9. HIT/KILL AVOIDANCE TECHNOLOGIES														
A. Technology Awareness														
(1) NADR Reviews (1)		O	O			O		O		O		O	O O	O O
(2) Armor Anti-Armor/CLASP Participation (1)			O			O		O		O		O	O O	O O
B. New Materials BAA														
(1) Joint LO Armor Development with Army/Navy (2)								S						O
(2) Smart Munitions Defeat									S					C
(3) Top Attack Defeat									S					C
(4) Smart Material Armors								S						C
C. Advanced CERMET Armor Technology		S		CRT (PE63611M)										

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Scheduled Meeting
2. BAA will continue to generate new starts to address technology voids that materialize as OMFTS matures as a doctrine

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: MANEUVER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 10. INTEGRATED SURVIVABILITY AND SPECIAL PROGRAMS														
A. RSTA-V Mine Survivability Analysis														
(1) Contract Award					S			C						
(2) Technology Research & Development					S			C						
(3) Final Report								R						
(4) Transition									T (PE63640M)					
B. Threat Oriented Survivability Optimization Model (TOSOM)														
(1) Contract Award					S			C						
(2) FLCV Data Base Generation					S			C						
(3) TOSOM Enhancements for USMC Vehicle Applications							S	C	R					
(4) Transition									T (PE63640M)					
C. JASE The technology developed under this task is classified information regarding technology development and associated milestones are classified. This task is jointly funded with the Army *Transition to appropriate PM's.*														
D. ALCOS The technology developed under this task is classified information regarding technology development and associated milestones are classified. This task is jointly funded with DARPA *Transition to appropriate PM's.*														

MILESTONE SYMBOL LEGEND

S = Start	--- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 1. MOBILITY TECHNOLOGY

Problem/Deficiency

The key to OMFTS is the mobility of naval forces at sea, the rapid buildup and maneuver of combat power inland, and the early accomplishment of critical objectives. Although some new systems are currently being developed (e.g., V-22 Osprey and the Advanced Amphibious Assault Vehicle (AAAV)), even newer, more technically advanced systems are required to project power over larger distances, more quickly, and in a seamless manner. To overcome these hurdles and successfully execute OMFTS, new technologies must be developed, along with operationally feasible concepts, to meet the component and system level deficiencies which currently exist.

Technical Objectives/Expected Payoffs

The technological thrust of this task is to enhance or improve the mobility characteristics of all Marine Corps surface elements envisioned to accomplish future missions such as joint littoral operations, amphibious assaults, political operations, sustainment, and combat support roles. Alternative concepts, platforms, and configurations will be developed and evaluated using traditional test and evaluation (T&E) methods as well as advanced M&S tools to assess mobility characteristics, system performance, and concept feasibility. To improve the mobility of future systems, innovative components, subsystems, and platforms need to be continually assessed and developed. These efforts range from the evaluation of enhanced suspension and more efficient drive trains to the development of future assault and sustainment platforms. The expected payoffs will be the attainment of new components and subsystems required for mid-term and future warfare vehicles and the maturation of new system concepts to support the successful conduct of OMFTS.

Technical Background And Approach

Two main pillars of "Forward...From The Sea" and OMFTS are the ability to project power from seabased ships and the sustainment of forces once initial inland objectives are met. Further descriptions of these capabilities reveal that maneuver assets will be required to travel up to 200 nautical miles of open ocean, transit surface and beach zones, and cross up to 60 miles of land terrain to reach mission objectives, all in a seamless manner. The technologies required to accomplish this end goal are challenging but not unattainable.

The primary thrust of this task will be the development and evaluation of advanced system platform concepts that accomplish mission roles with all the performance characteristics required of OMFTS. M&S based design tools will be employed to evaluate alternative chassis designs, total vehicle/platform system architecture, land and water mobility performance, and propulsion system efficiencies. The most promising concepts will be matured and analyzed for high

technical risk areas, cost drivers, and other system level issues. Individual projects will be initiated to address the most important issues to refine the concept and find feasible solutions. In addition, this task will continue to research, develop, and evaluate existing technologies that continue to show growth potential and further benefits. These include high horsepower density engines/power sources, high efficiency drive trains, and lightweight, corrosion tolerant, components. Contained within this plan is the technology roadmap which identifies those key developmental areas, their respective schedules, and the transition plan to go from feasibility evaluations to an Advanced Technology Demonstration (ATD).

Summary of Prior and Current Years' Work

During FY95, the development of advanced vehicle concepts was initiated. A total of 45 concepts were developed which addressed the spectrum of known operational functions and missions. These concepts were based on operational requirements derived through examination of current OMFTS, and related, doctrine. Through M&S assessment tools, these concepts were winnowed down to several key platforms that provided maximum payoff in operational utility and effectiveness. A BAA was issued during FY96 to solicit proposals related to these primary vehicle concepts: RSV, Future Light Combat Vehicle (FLCV), and the ELT. Several contracts for concept development and preliminary vehicle design were awarded during FY96. Contractors' efforts will include determining system level capabilities, conducting a technology assessment, and performing design trade-off analyses.

A key to guaranteeing the success of this effort is the implementation of Integrated Product/Process Development (IPPD) management principles. The IPPD strategy integrates all activities, from concept through development and testing, by forming multi-functional Integrated Product Teams (IPT) that simultaneously develop the design and the processes required to sustain the effort. To this end, future detailing of concepts will be done through joint teaming arrangements formed between US Army, DARPA, USMC, and contractors. Early coordination has focused on customer (e.g., military user) requirements and the formation of an advisory group to assist in directing the conception efforts. The group addresses such mobility issues as operational requirements, technology transfer, and fiscal planning and execution.

During FY96, modeling simulations were performed using the HTMMP/AEDT platforms to assess the rollover and safety modes for their operations. Also, an effort was conducted that evaluated and confirmed that the HTMMP/AEDT platform would fit within the V-22. In addition, other V-22 interface issues were addressed. An extensive effort in the Light Strike Vehicle (LSV) program including coordination with the PM for Ground Weapons (PM-CBG) and Special Operations Command (SOCOM), transitioned into a vehicle acquisition program.

Planned Work

FY97 efforts will involve continued detailing of vehicle concepts, identification of technology development efforts, and acquiring additional assessment tools to evaluate system

and subsystem level performance. All concepts of future systems will be developed to produce future desired mobility characteristics. These new concepts will address Concepts of Operation (CONOPs) formulated during the Expeditionary Warfare Roundtable I. This CONOP is targeted for the 7-20 year time frame and beyond. Platform concepts will be developed that address the main tenet of "From The Sea" - the ability of naval forces to project power ashore from seabased ships. Such systems or platforms will require the range, speed, and maneuverability to deploy from a seabase distances up to 200 nautical miles, seamlessly transit surface and beach zones to attack objective areas as far as 60 miles inland, and avoid/counter the numerous obstacles/threats that lay in wait. The concept vehicles are deployed and utilized in conjunction with other complementary warfighting assets such as vertical lift and assault forces. The RSV is designed for internal transport in the V-22 tiltrotor aircraft. This vehicle must maintain high mobility characteristics while fitting within a very tight volume envelop. The FLCV seeks to address deficiencies in the current Light Armored Vehicle (LAV) by designing a superior vehicle with high mobility, increased lethality, and improved survivability. All concepts developed, and their associated technologies, will be leveraged together to develop common components, subsystems, and systems. All forms of system configurations will be investigated including self contained vehicles, delivery platforms, and seaworthy adaptations to advanced land systems.

Improving the surface mobility of future Marine Corps assets will require innovative and revolutionary means of propulsion, maneuvering, and seamless transitioning. The principle IPTs will address all aspects of these developments such as operational, human factors, affordability, producibility, and technical risk. Once promising concepts, systems, or platforms emerge, advanced modeling techniques will be implemented to determine preliminary performance feasibility and combat effectiveness. Hydrodynamic and land mobility modeling will be conducted on the most promising platform designs.

Transition Plan

As promising technologies mature within this task, they will transition via the program elements to ATDs or individual PM systems. As an example, the MARCORSYSCOM PM-CBG and PM for LAV (PM-LAV) have sponsored and funded two separate initiatives to develop concepts and analyze technology for future vehicle programs.

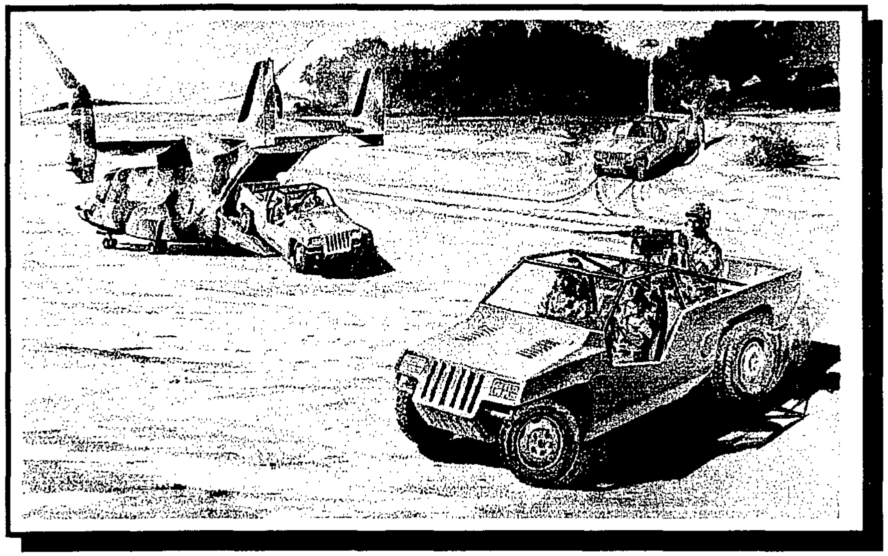
Relationship to Other Programs

The US Army Tank-automotive Research, Development and Engineering Center (TARDEC) is heavily involved in the effort to develop vehicle concepts, transfer key technology, and coordinated with Battle Labs to determine US Army requirements. Their involvement at this early stage will provide a smooth transition to anticipated future joint ATD efforts.

In addition, a Small Business Innovative Research (SBIR) contract was awarded in FY95 for the design and evaluation of a better all terrain tire which will exhibit traction in rough terrain equal to a tracked propulsion system. This six month effort was completed in FY96.

THIS PAGE INTENTIONALLY LEFT BLANK.

MOBILITY TECHNOLOGY



OBJECTIVE:

- TECHNOLOGY INSERTION OF ADVANCED COMPONENTS AND SYSTEMS INTO EXISTING AND FUTURE PLATFORMS TO IMPROVE OPERATIONAL CAPABILITY

CAPABILITIES:

- S&T ROUNDTABLE ISSUES BEING ADDRESSED:
  - INCREASE SHOOTER MOBILITY (G-Q2)
  - INCREASED SPEED AND RANGE (Y-Q2)
  - INCREASED PLATFORM EFFICIENCY (G-Q2)
  - MODULAR WEAPON / COMBAT SPT TRANSPORT (Y-QI)
- MNS FOR LIGHT STRIKE VEHICLE:
  "HIGHLY MOBILE, RELIABLE"
- MNS FOR FLCV:
  "...HIGHLY MOBILE AND SURVIVABLE.."
  "...MAXIMIZING MOBILITY"

APPROACH:

- PROVIDE ANALYSIS, MODELING, DESIGN SUPPORT FOR VEHICLE AND INTEGRATION EFFORTS:
  - STOCHASTIC MOBILITY MODELING OF GCE
  - TERRAIN DEFINITION FOR DEFINING MOBILITY CHARACTERISTICS AND CRITERIA FOR USMC SCENARIOS
  - VEHICLE INTERFACE FOR ADVANCED BREACHING
  - POTENTIAL WATERSPEED IMPROVEMENTS FOR AAV-7A1
  - HYBRID-ELECTRIC DRIVETRAIN FOR IMPROVED FUEL EFFICIENCY
- JOINT PROGRAM WITH DARPA, US ARMY
- POTENTIAL SUPPORT TO URBAN WARRIOR AWE

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
MOBILITY MODELING	▲			△
AAV SPEED	▲	△		
LSV MS I			△	
FLCV MS 0		△		
ADV BREACHING		△		△

PERFORMERS:

- NSWC-CARDEROCK, ARMY-WES, CASDE, RMSV, AEROVIRONMENT

TRANSITION:

- PM-LAV, PM-GROUND WEAPONS, DRPM-AAA, PM-AAV, PM-SSC

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 2. TACTICAL AND ELECTRIC VEHICLE TECHNOLOGY

Problem/Deficiency

The Marine Corps currently utilizes a diverse variety of tactical vehicles to achieve its many combat support mission objectives. Some of these vehicles still employ post World War II technology such as heavy mechanical transmissions, diesel power plants, and inflexible mechanical drive trains. Current combat, combat support, and combat service support assets exhibit unique and sometimes disparative mobility characteristics. For example, such a mismatch in mobility led to several instances of unsupported combat elements conducting fast moving maneuvers during Operation Desert Storm. This task, therefore, focuses on the development and demonstration of advanced technologies that enhance the overall mission capability of the tactical vehicle fleet. Emphasis is placed on wheeled vehicles and improving the mobility (e.g., maneuverability, speed, and range), payload, and overall operational suitability of existing vehicle systems. In addition, new vehicle concepts will be developed that meet future mission requirements such as transport, stealth reconnaissance, light weapons platform, sustainment, and other related mission variants.

Technical Objectives/Expected Payoffs

Future tactical vehicles and platforms will be required to deliver more payload over longer distances and in quicker times than ever before. This can only be achieved through leveraging the latest vehicle technology and developing those technologies which provide the greatest payoff for the least amount of technical and financial risk. Scalable technologies will be investigated such as electric drive trains, energy storage systems, and improved suspensions which can be applied across the spectrum of tactical vehicle types and mission variants. The vehicle and system components developed under this task will be capable of performing in mission roles from scout/reconnaissance to transport and first-to-fight combat roles.

Technical Background and Approach

Conventional tactical vehicles are powered by internal combustion engines and hydro-kinetic or mechanical transmissions. Hybrid-electric drive for tactical vehicles offers potential higher range and efficiency, lower emissions, lower thermal and acoustic signature (almost zero under pure electric running), and greater component and system reliability. This is due to the implementation of electric power to supplement the transient power requirements of the vehicle when compared to a vehicle powered by an internal combustion engine only. As such, a smaller engine can be employed in this application. Weight, cost, and maintenance penalties associated with having two separate power sources are offset by the smaller size of the engine and greater reliability associated with cycling the engine less often, operating at peak fuel efficiency, and being able to drive in the event of either an engine/alternator or battery failure. The JTEV project, begun in late FY93, demonstrates this hybrid electric vehicle approach.

Summary of Prior and Current Years' Work

The AEDT design phase was successfully completed in FY94. The fabrication phase, which began in FY94, was completed in FY96 along with contractor acceptance testing.

The JTEV project successfully completed fabrication in FY95. The JTEV is based on the same design parameters as the HTMMP but, through the use of a hybrid electric drive train, it uses a much smaller diesel engine/alternator power plant. Electric energy from batteries assist in powering two electric motors, each driving front and rear mounted differentials. The JTEV utilizes Off the Shelf (OTS) components from the electric vehicle industry to demonstrate and investigate technology transfer. The JTEV successfully completed contractor acceptance testing during the 2nd half of FY95. These shakeout tests involved the synchronization of the hybrid drive and control systems. Additional tests and demonstrations were conducted in FY96 under joint USMC-DARPA efforts.

The APS vehicle contract was modified during FY95 to accomplish final integration and repairs on the fully electric drive amphibious vehicle. The repairs to the alternator were completed in FY96 and contractor acceptance testing began in late FY96.

Planned Work

During the 4th quarter FY96, the APS vehicle began acceptance testing at the contractor's facility. Continued tests will involve synchronization of the land and water electric control systems, optimization of the drive trains, and general shakeout of the total vehicle. Contractor tests will be conducted over a variety of land terrain (e.g. pavement, rough cross country, and slopes) and water/surf transit. Characteristics such as range, speed, acceleration, braking, and obstacle negotiation will be tested to evaluate land mobility. Speed, acceleration, transitions, and reverse will be evaluated in water mode. Results will be compared with performance levels of conventional mechanical drive vehicles.

Early FY97 efforts for the JTEV will involve refurbishing the vehicle after contractor acceptance testing. Upon completion and delivery to the government, the JTEV, along with the HTMMP/AEDT and APS vehicles, will transition to the Joint Integrated Electric Mobility Demonstrations (JIEMD) ATD where they will be utilized for demonstrations, evaluations, and further electric drive technology testbeds. Because the JTEV, AEDT, HMMWV, and HMMWV with passive trailer are of the same weight class and operationally the same class of vehicles, common tests and test procedures will be conducted and compared to see what performance gains are realized with electric drive trains and powered trailers. Tests may be performed at Nevada Automotive Test Center (NATC) since NATC is preparing new electric drive vehicle test procedures for evaluating system level performance of various types of electric and hybrid electric drive vehicles. These evaluations will be conducted jointly with the US Army TARDEC and results will be incorporated into the government's electric drive programs.

Transition Plan

As technologies are developed and demonstrated, they will be transitioned to the appropriate elements within the USMC, US Army, and DARPA ATDs, ACTDs, and acquisition programs.

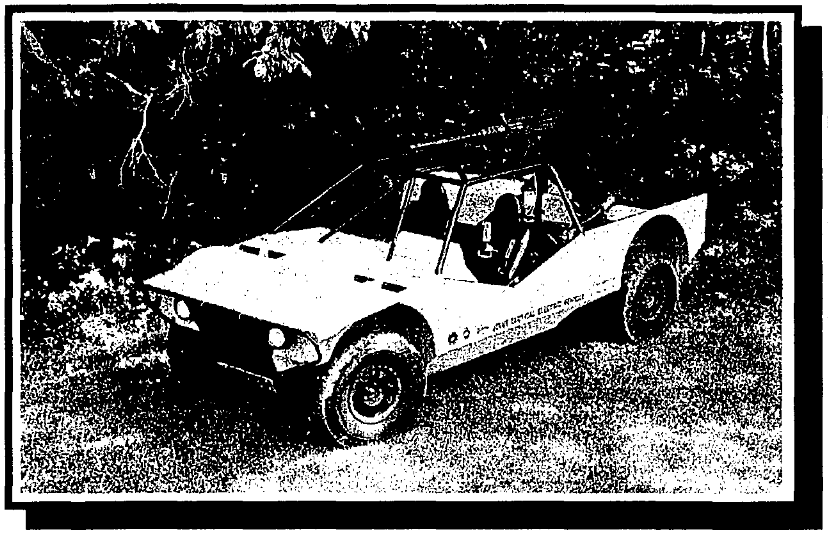
Relationship to Other Programs

This task is very closely monitored by the US Army's Electric Vehicle Technology program and the DARPA's Electric Vehicle/Electric Hybrid Vehicle (EV/EHV) program. The US Army developed an electric drive HMMWV and has intentions of applying electric drive technology to future tracked combat vehicles. DARPA, through congressional direction, is managing the large scale demonstration and technology development of electric componentry for automotive passenger and military vehicle applications. A FY95 new start within DARPA addresses electric componentry commonality between the military and commercial sectors, to include development and demonstrations. To coordinate these efforts, a Joint Electric Propulsion Technology Program (JEPTP) Letter of Agreement (LOA) was drafted and signed in FY94. The Executive Committee of the JEPTP is comprised of the Technical Director, US Army TARDEC; Director, Tactical Technology Office (TTO), DARPA; and the Director, AWT Directorate, MARCORSYSCOM. The LOA facilitates the sharing of technology and provides for the opportunity to engage in joint development efforts along common objectives relating to electric drive technology.

In addition, an SBIR program was initiated in FY95 for improving the mobility of the HMMWV. The effort involves replacing existing suspension components with newer, advanced shocks and springs to increase wheel travel and improve ride quality and vehicle cross country speed. This effort was completed in FY96.

THIS PAGE INTENTIONALLY LEFT BLANK.

TACTICAL AND ELECTRIC VEHICLE TECHNOLOGY



OBJECTIVE:

- ASSESSMENT, DEVELOPMENT AND TECHNOLOGY INSERTION OF CRITICAL COMPONENTS TO PROVE VIABILITY OF ELECTRIC AND HYBRID ELECTRIC DRIVE IN USMC COMBAT OR TACTICAL VEHICLES.

CAPABILITIES:

- S&T ROUNDTABLE ISSUES BEING ADDRESSED:
  - SIGNATURE REDUCTION (Y- QI)
  - INCREASED SPEED AND RANGE (Y-QII)
  - INCREASED PLATFORM EFFICIENCY (G-QII)
- MNS FOR LIGHT STRIKE VEHICLE: "HIGHLY MOBILE, RELIABLE"
- ADDRESS CWL NEED FOR "DECEPTION/STEALTH"

APPROACH:

- DEVELOP AND DEMONSTRATE V-22 INTERNAL TRANSPORTABLE PLATFORMS FOR FUTURE USMC/SOCOM MISSIONS:
  - HYBRID ELECTRIC DRIVE FOR FUEL EFFICIENCY
  - IMPROVED PACKAGING AND LAYOUT
  - IMPROVED MOBILITY IN NARROW PLATFORM
- JOINT PROGRAM WITH DARPA, SOCOM
- POTENTIAL SUPPORT/APPLICABLE TO URBAN WARRIOR AND CAPABLE WARRIOR AWEs
- TRANSITION TECHNOLOGY TO RST-V ATD (FY98)

PERFORMERS: NSWC-CARDEROCK, AEROVIRONMENT, ROD MILLEN SPECIAL VEHICLES

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
HTMMP TESTING WITH AEDT	▲	△		
JTEV TESTING	▲		△ DARPA COMMENTS	
SPT LSV TESTS		△		
TRANSITION RST-V			△	

TRANSITION:

- PM-GROUND WEAPONS, USSOCOM

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 3. JOINT MINE DETECTION TECHNOLOGY

Problem/Deficiency

The Marine Corps, as well as the Army, has both an urgent and continuing need for the capability of remotely detecting all types of land mines from ground combat units and vehicles as well as from airborne platforms such as an Unmanned Aerial Vehicle (UAV). The Marine Corps has a unique requirement for mine detection from the surf zone/beach area to inland battlefields during an amphibious assault. The technical deficiency and the continuing challenge is that a deployed, standoff mine detection capability currently does not exist.

Technical Objective/Expected Payoffs

The Mine Detection Technology Program has effectively demonstrated that a video-based, multi spectral imaging system, coupled with appropriate image processing, is a powerful technique for remote mine detection. Based on the work previously performed in the 6.2 Mine Detection Technology Program, several advanced imaging technologies and physics-based image processing techniques will be investigated, developed, and tested. The initial technical objective is to develop a digital, multispectral, imaging camera with tunable filters capable of adjusting imaging wavelengths, as needed, to detect any variety of mine deployed. A further technical objective is to demonstrate and, if appropriate, develop a passive MMW imager capable of collecting imagery at night and/or through fog. A third technical objective is to develop technology which will make possible a lightweight, active, multispectral, imagery possessing multiple wavelength capability in the visible and near IR and with ATR capability. These imagers would all detect land mines (and other targets) at standoff distances from an unmanned vehicle, either air or ground.

The expected payoff would be a lightweight, compact system deployable either on land or air platforms for detecting land mines through obscurant and amid clutter either by day or night. A variety of targets camouflaged to blend into the background will be detectable. Imaging systems equipped with enhanced processing capability will be able to detect the presence or absence of a minefield prior to deployment of the Marines to a combat zone, with a measurable degree of confidence. Based on the configuration and range of the threat area and mode of reconnaissance prior to force deployment, it would be possible to detect individual antitank and antipersonnel mines, including shallow buried mines and mines in shallow water, with high reliability and to localize them for subsequent neutralization. This will significantly increase the mobility of combat units and the probability of successful mission completion.

Technical Background and Approach

In cooperation with the US Army and DARPA, the Joint Mine Detection Technology task will continue to investigate a synergistic approach to mine/minefield detection through advanced

sensor development and comprehensive, physics-based image processing. The currently emphasized technical thrust is to investigate and develop a TFMC whose imaging sensors will yield data which can be computer processed for automatic mine/minefield detection.

Multispectral, video-based cameras have been demonstrated to have a capability to detect mines amid clutter by optimal selection of frequency bands and select image processing techniques. Spinning filter wheels with fixed filters can give a set of bands, and consequent multispectral capability, but are sensitive to camera motion. Moreover, the filter selection is fixed for a given mission. Rapid tunable filter technology would permit simultaneous collection of multiple-band imagery and lend itself to far more rapid data collection with a higher degree of selectivity. The inclusion of co-registered images in the IR bands would enhance the mine detection capability, especially that of buried mines. The advanced multispectral imaging approaches developed in response to the need for remote mine detection have the characteristic of generating very large amounts of imagery in a very short time. So that data overload will not prevent efficient use of the imagery for mission performance, an ATR capability will be pursued for mine/minefield detection, clutter rejection robust to the environment, and a multi-sensor capability with improved detection over that possible with any single sensor system, including the detection of shallow buried mines. The goal is automated mine/minefield detection with a known degree of confidence and low false alarm rates.

Alternate sensor technologies will be investigated to enhance the ability to operate in adverse environments (fog, rain, night, turbid water). Critical proof of concept demonstrations using existing hardware will be conducted prior to initiation of any further investigation or development. Every effort will be made to leverage with other programs and services. The aims of further technology development will be to continue to extend the standoff ranges for multispectral mine detection and improve performance for buried and underwater detection by day or night and in adverse weather. The resources available to contractors, National Laboratories, and the university sector will be accessed, as appropriate.

Passive MMW technology will be investigated because of its potential to image at night and through adverse weather and, possibly, battlefield obscurants. The passive nature of this technology gives it countermeasure resistance. Recent advances in sensor fabrication have created lightweight and compact MMW sensors which were unavailable until very recently. Sensors of this type will be tested for their utility in the mine detection mission. Exploration will be made of the potential for augmenting the passive TFMC with an IR channel and with multiple-wavelength laser illuminators in the visible and near IR wavebands. Very high efficiency pulsed lasers coupled with range-gated operation of the passive imager will provide a capability to operate at night and to penetrate obscurants.

The entire field of electro-optic (EO) imaging sensors is in a state of rapid development, driven by commercial requirements, materials developments, and advances in distributed computer processing. Advanced technology developments in interferometry, spectrometry, and human perception will be continuously monitored and assessed for potential usefulness in the mine detection mission.

Summary of Prior and Current Years' Work

In FY95 and FY96 work was concentrated on defining the design and initiating procurement of a multispectral imaging camera capable of deployment on a UAV. Design studies established that: (1) Multispectral classification studies indicate that the greatest utility is obtained by working in the visible and near IR bands and that tunable filter imagers utilizing Liquid Crystal Tunable Filters (LCTF) technology are feasible there. (2) The overall driver for meeting mission requirements is spatial resolution. Mine classifiability is more sensitive to resolution than band selection. Extremely high resolution image intensifiers are becoming available from Army work stimulated by realization of the strong tactical edge conferred by better night vision devices and from DARPA developments. (3) A "finder camera", with wide field of view (FOV) may be desirable to position the imagery. (4) Mid range IR, at 3.0 - 5.0 μm, implemented in cooled InSb arrays, is desirable on the grounds of relatively high available focal plane array (FPA) resolution and superior differential contrast. Against this, DARPA work has recently confirmed a measurable effect in the thermal IR (9.0-11.0 μm) arising from changes in the material characteristics of earth disturbed by the act of burying a mine. (5) Aspheric/ diffractive optics permits implementation of zoom lenses at large savings of weight and volume facilitating operation at altitude at some price in multi spectral image registration capability. (6) High imager resolution implies a necessity for compression of digital data before transmission in foreseeable scenarios.

Based on assessment of these studies, procurement of a technology demonstration of a TFMC was undertaken under the Dahlgren BAA for Communicating Tactical Battlefield Information. The Xybion Corporation was chosen after careful evaluation of all proposals. They have evolved a design for a multi-barrel camera with coverage in the 370 to 900 nanometer (nm) band. This effort entailed an end-to-end evaluation of several distinct configurations. The design was taken to an intermediate level of detail to estimate cost and performance with confidence. A filter-in-front configuration using LCTFs proved attractive because of its low volume and cost and high versatility and maintainability. A measure of performance proved to be obtainable in the ultraviolet (UV) region above 370 nm which can be important in dealing with background clutter. Registration in the hardware was obtainable to within three pixels. The modularity of this option facilitates later addition of an IR channel. Data will be recorded in analog form in the 6.2 phase of the program but a digital capability can be incorporated in later versions of the camera should digital recording and/or data transmission evolve to a point where it offers advantages over analog recording and transmission. The detailed design of the camera occupied the latter part of FY96 and all critical design decisions were finalized and approved in a Preliminary Design Review (PDR).

The algorithm suites developed previously have been combined into a "best" version as a baseline suite for COBRA. A Minefield Image Synthesis Tool (MIST) which models all important physical effects related to a passive visible sensor viewing a minefield has also been developed. Radiances are modeled with target geometry in three dimensions, target reflectances, and all pertinent environmental effects taken into account. Texturing is used to introduce a pseudo-randomness to material reflectance and translucence is used to allow material properties of an underlying object to influence pixel values of an object above. The modeling was

compared with, and the image processing techniques tested upon, the data base gathered in the COBRA Developmental Test (DT)-0 testing. The objective was to verify the quality of the algorithms and to determine detailed execution times for later implementation in real time hardware. An algorithm was also developed to determine the correct settings to remotely tune the TFMC in an operational situation.

The LLNL has been tasked to determine the feasibility of constructing lightweight, compact, diode laser arrays at 810 nm for the purpose of providing the TFMC with a self-illumination capability. This is to be done by adjusting pulse repetition rate to synchronize with the camera and economize power, and by the use of micro-lenses to focus the beam on the desired FOV.

The Mitre Corporation has, in support of the COBRA program, pursued development of a near real time processing system consisting of a super VHS tape recorder, a near real time frame grabber and digitizer, and a fast processor operating on a simplified algorithm set. Use was also made of the Army's MODSAF model to model COBRA system performance and usefulness in operational scenarios. This model was transferred to CSS Panama City, for use by the COBRA program. Mitre has also analyzed options available to COBRA for transmission of imagery in real or near real time.

The Nichols Research Corporation has been tasked to assess passive MMW technology for mine detection. To date: (1) A relatively simple model has been developed and implemented that can be used to compare theory with experiment and assess the effectiveness of given technical choices; (2) A three-channel, scannable, spot radiometer developed by the Millitech Corporation for the Air Force Smart Tactical Autonomous Guidance (STAG) program has been used, in cooperation with the Air Force, to image mines under snow, ice, and earth. Model-derived imagery has been successfully compared with the experimental imagery. (3) Calculations from the model indicate that operation at 94 Gigahertz (GHz) provides the best compromise between resolution and receiver noise. Moreover, 94 GHz is relatively insensitive to weather variations compared with higher frequencies. Independent of the Nichols effort, it has been proposed that synthetic aperture techniques may be usable to drive up imager resolution and achieve a package deployable in a UAV.

Planned Work

In FY97, the technology demonstration of the TFMC will be completed. The contractor has been tasked to conduct the detailed design, development, fabrication, and ground testing of a three-channel, lightweight, compact TFMC capable of acquiring high resolution imagery in three spectral bands from an airborne platform. Imagery is to be recorded on analog tape although the camera will be designed for easy modification to deliver digital data should that prove advantageous. The eventual intention is to transmit the imagery to a ground station via a data link of the type existing on UAVs under development. The camera system is to cover a wide spectral range of 0.37 - 0.9μm with a suite of boresighted, electronically tunable, solid state imaging devices for the collection of coregistered, multi spectral imagery in three spectral bands.

Two channels will cover the spectral region between 0.37 and 0.7 μm. One channel will cover the region between 0.7 and 0.9 μm. Room has been left for a fourth channel which will cover the region either between 3 and 5 μm or 8-12 μm, depending upon which band proves most advantageous. Each channel will be independently tunable within its spectral range. High sensor resolution will be stressed. Final design of the camera will be examined in a Critical Design Review (CDR), after which fabrication will proceed. The camera will be tested over mine fields at Naval Surface Warfare Center (NSWC)CSS and other locations, if appropriate, using a Cessna aircraft as the initial test bed. Successful demonstration will permit ready transition to an ATD.

Image processing and modeling efforts will continue to be conducted with a view towards strong support of the COBRA program. The objective of the image processing technology efforts will be to obtain more robust performance at greater speed, aiming for near real time. It is also necessary to enhance minefield detection capability. To achieve these objectives, the current optimized mine detection ATR algorithm suite is being tested on the database collected during the COBRA DT-0 tests with algorithm execution times tracked to trade off performance versus computer requirements. It has been determined that a key to reduction of false alarm rate is development of an improved classifier. This will be stressed in the coming year. Classification capabilities will be improved by adaptive prediction of mine spectral signatures along with combination of spectral and spatial feature extraction techniques. The algorithm for tuning the TFMC will be implemented in software and tested during the technology demonstration of the TFMC. An attempt will be made to develop a robust, buried mine detection algorithm by multi spectral analysis of surface scarring and vegetative stress. This effort will be interrelated with the effort described below to choose an appropriate technology for an IR channel for the TFMC. Successful 6.1 developments will be considered for integration into the algorithm package as they mature. Possible examples include the morphology algorithms developed by Johns Hopkins, the wavelet techniques developed at NSWCCSS, and the "top down" approach now being investigated at Brown University.

Work on the fixed-but-multiple wavelength illuminator was initiated in FY96 at LLNL. The 810 nm array will be completed and tested in the first quarter of FY97. Then an array will be fabricated to operate at 670 nm, on the other side of the chlorophyll transition. Imagery collected at these two wavelengths will be suited to highlight mines at maximum contrast. This illuminator is intended for installation in boresighted fashion with the TFMC after it is developed and tested. The development of the TFMC will be conducted with this in mind. A significant question remaining is the preferable technology for a blue-green channel operating at the efficiencies needed for small platform implementation. The candidate technologies include doubled diode-pumped Nd:YAG, microchip lasers, and blue diode technology. After assessment, a technology will be selected and illuminator design initiated. The self-illumination capability will make possible operation at night and in more of the surf zone than is open to purely passive imaging sensors.

The most obvious extension of the TFMC will be an IR channel and this will be pursued. It will offer the advantages of passive operation at night and provision of improved classification of mines. Work done under DARPA auspices and work at NSWCCSS will be reviewed in deciding which of the two main wavelength bands should be incorporated in the camera. Issues

of compatibility with the visible/near IR channels of the TFMC will also be resolved. The camera/filter technology chosen will be sized to a UAV platform. A point design will be produced for review before fabrication.

It is also intended, in FY97, to initiate development of a passive MMW imager which is capable of mine detection, deployable on a UAV, and suited for passive detection of mines at night, in poor weather, and which may be buried under a dry overburden. The approach is to couple passive MMW imaging with advanced synthetic aperture image formation techniques based upon passive interferometric imaging, an approach which has been successfully used both in radar and in thermal IR. This approach offers the possibility of passive MMW imaging from light airborne vehicles at resolution high enough to detect and image mines. At first, technology and tradeoff studies will be conducted of the imaging geometry, basic MMW phenomenology of interest to system performance, motion sensing requirements, and image formation requirements. Critical radar/radiometer parameters will be traded off in sufficient depth in order to converge to a potentially viable point design. The technology assessment and experimental results obtained in FY96 will be fed into the effort. FY97 work would conclude by identifying components needed to construct a baseline, two-aperture, interferometric sensor and define a concept for a feasibility demonstration model which could be tested in the laboratory and in the field.

Transition Plan

Upon completion of development, the TFMC will be augmented with a data link and image transmission capability and tested in a UAV under an ATD. Subsequently, it will be incorporated into the COBRA system as a Pre-Planned Product Improvement (P^3I). The self-illuminated camera will enter advanced developed under Program Element (PE) 63640M after completion of the necessary ATD documentation.

Relationship to Other Programs

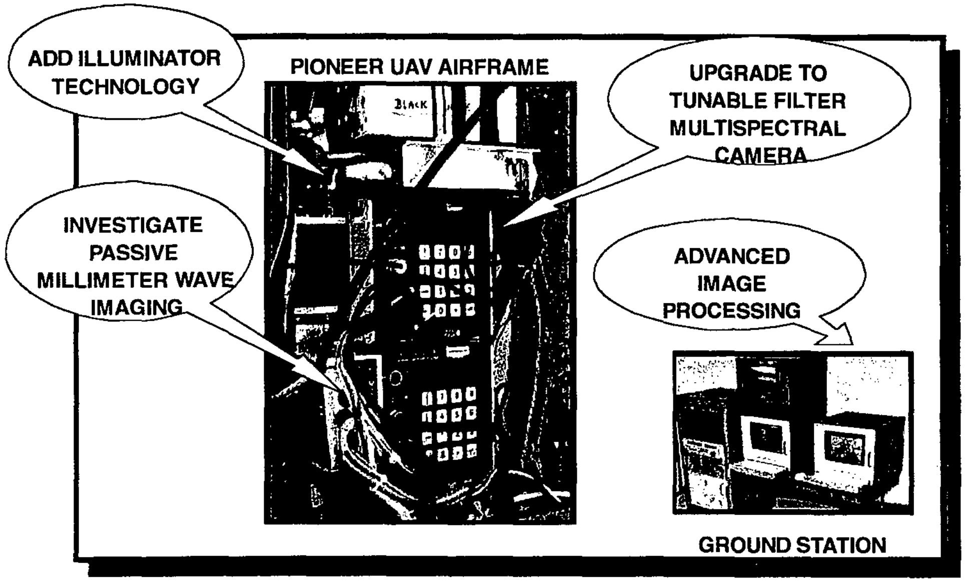
Several programs being conducted by other agencies bear directly or indirectly on mine detection. This program will maintain liaison with all of them, as necessary. The Army is carrying out the Airborne Standoff Minefield Detection System (ASTAMIDS) development with the intention of acquiring an airborne remote mine detection capability. Emphasis is on thermal IR (passive) and/or near IR (active) technology. Concurrently, the Army is carrying out a Technology Demonstration (TD) of a Mine Hunter/Killer designed to implement both detection and neutralization capabilities at maneuver speeds on a ground vehicle. IR, UV, and radar sensors are under investigation. A vehicular mine detector utilizing a multisensor approach involving high resolution X-ray imaging, ground penetration radar, and forward looking IR technologies is also being pursued under applied research. Several technologies, including IR imaging, are being demonstrated under the Close-In Man Portable Mine Detector ATD. All of these programs will be closely monitored by the JMDT task to determine whether any innovative technologies developed in these programs are applicable to the Marine Corps mission.

DARPA is conducting a hyperspectral mine detection program in which two Fourier transform spectrometers capable of developing imagery in successive narrow bands in thermal IR are being tested against buried mines. These tests and their results will be watched to determine if distinctive and robust signatures in the IR can be developed by sensors of this type. DARPA is also developing a 40 X 26 array passive MMW imager at a frequency of 90 GHz under a Phase I Technology Reinvestment Program, with National Aeronautics and Space Administration (NASA)/Langley as the technical agent and TRW as the contractor. A Joint Marine Corps/DARPA Memorandum of Understanding (MOU) on mine detection is in staffing.

Passive MMW technology is being pursued by the Air Force for purposes of target seeking. Any efforts by JMDT in these areas will be actively coordinated with the Air Force in order to leverage optimally on the Air Force investment. An example used this year is the aforementioned Air Force STAG program. A Joint Marine Corps/Air Force MOU is under consideration.

THIS PAGE INTENTIONALLY LEFT BLANK.

JOINT MINE DETECTION TECHNOLOGY



OBJECTIVE:

- PROVIDE TECHNOLOGIES CAPABLE OF HIGH AREA RATE STANDOFF MINEFIELD DETECTION AND BEACH DEFENSE RECONNAISSANCE IN SUPPORT OF AMPHIBIOUS OPERATIONS

CAPABILITIES:

- S&T ROUNDTABLE NEEDS:
  - HIGH AREA RATE STAND-OFF RECON (R-Q2)
  - FULL RECONNAISSANCE IN SURF/BEACH ZONE (Y-Q1)
  - NON-METALLIC MINE DETECTION (Y-Q2)
- SHALLOW WATER MINE COUNTERMEASURE ORD

APPROACH:

- LEVERAGE ARMY ASTAMIDS TECHNOLOGY
- DEVELOP TUNABLE FILTER CAPABILITY FOR DIGITAL MULTI-SPECTRAL IMAGING CAMERA
- DEVELOP AND DEMONSTRATE PASSIVE MILLIMETER WAVE IMAGER
- DEVELOP REAL TIME AUTOMATED TARGET RECOGNITION (ATR) ALGORITHMS FUNCTIONAL WITH DATA FUSION FROM SENSOR ARRAYS
- DEVELOP LOW LEVEL IMAGE INTENSIFYING ILLUMINATION
- DEMONSTRATE ON AIRCRAFT AND PIONEER UAV
- TECHNOLOGY INSERTION

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
DEV TUNABLE CAMERA	▲	△		
DEV ACTIVE ILLUMINATOR	▲		△	
DEV REAL TIME ATR	▲			△
DEV PASSIVE MMW	▲			△
INTEGRATE/TEST			△	△
TRANSITION			△	△

PERFORMERS:

- NSWC/PANAMA CITY, XYBION CORP, NICHOLS RESEARCH

TRANSITION:

- COBRA, JOINT STANDOFF MINE DETECTION ATD

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 4. DISTRIBUTED EXPLOSIVE TECHNOLOGY

Problem/Deficiency

The modern landmine threat includes a variety of technologically advanced and countermeasures hardened landmines. Included are fuzes with many sensor types with ever-improving capability to destroy vehicles while withstanding the effects of mine countermeasure (MCM) systems. Present mine neutralization systems rely primarily on explosive clearance techniques, physical removal of the mine from the vehicle's path, or a simple magnetic signature duplication. Currently, fielded explosive mine neutralization system effectiveness has been reduced to reliable actuation of only simple, non-hardened, first generation fuzing mechanisms. For the Marine Corps to provide its forces with the capability for rapid amphibious assault and subsequent operations ashore, a MCM system that is effective against the threat as a whole is needed. Additionally, both Combat Engineers and Explosive Ordnance Disposal (EOD) teams require the inclusion of new and emerging technologies that will increase capability in demolition, minefield clearing, and single mine disablement operations. The technical challenge of this task is to demonstrate that DET will neutralize landmine targets regardless of mine type, fuzing, or hardening against explosive/electronic MCM.

Technical Objectives/Expected Payoffs

The result of this task will be the development of MCM technologies that will defeat all present and future mine threats encountered, regardless of type, fuzing, or hardening. The use of this technology in future system development efforts will significantly increase the Marine Corps' combat capabilities in clearing mine threats during deliberate breaching, administrative, and demolition operations. The primary payoff in the development of new systems will be the maintenance of combat power, speed, and flexibility inherent in OMFTS doctrine. The primary goal for development is long term (i.e., 10-plus years in the future).

Technical Background and Approach

Current state-of-the-art methods for landmine and demolition operations include use of explosives, mechanical devices, magnetic signature simulations, or manual removal. All of these techniques depend upon actuation of the fuze or physical removal of the threat. Upgrades and changes to landmine fuzing (i.e., hardening) and the use of multiple sensor/actuation fuzing have seriously degraded the effectiveness of conventional mine clearing techniques. Merely increasing the quantity of conventional explosives or other breaching systems used in mine neutralization is inefficient and can result in burdensome logistical requirements. Likewise, developing specialized systems to operate against specific mine or fuze types have the same effect. New technology must be developed to neutralize threat mines regardless of type, fuzing,

or hardening and still be supported logistically under combat conditions. Because the commonality of all mines is the explosive main charge, the ideal mine neutralization system will defeat the main explosive charge and/or disable critical components.

This task addresses a new approach for landmine countermeasures based upon the use of distributed explosives (i.e., explosives uniformly and/or efficiently arranged explosive charge(s)) that cover an area. When initiated, the explosive charge(s) uniformly clears a given targeted area. The distributed technology specifically addressed in this task, the Anti-Mine Munition (AMM), focuses on destroying all landmines regardless of fuze type in all combat situations and scenarios.

The AMM contains an explosive charge and a copper liner loaded into a plastic body. The munition may be deployed and initiated singularly for EOD purposes or, for minefield clearance, deployed and initiated as part of an explosive net. When initiated, metallic jets propel downward, penetrating through overburden and detonating the mine's main explosive charge. The kill mechanism, may be kinetic energy, chemical energy, or a combination of the two. Both domestic and foreign mines, steel and plastic cased, have been neutralized using this technology during field tests conducted from FY85 through FY96. Technical issues outstanding for the AMM are specific design modifications to optimize munition design, size, performance, safety, and cost. The optimization effort is seeking to exploit new and emerging technologies in explosives, warhead materials, munition manufacturing processes, and designs in order to improve the AMM's performance across the full standoff and overburden (type and thickness) ranges expected in tactical mine environments. The additional efforts added to this task to achieve this end are reflected in the milestone chart.

Summary of Prior And Current Years' Work

During FY96, and prior years, accomplishments for this task follow:

a. Completed the evaluation of detonation cord initiation of the AMM.

b. Completed the characterization of candidate liner fabrication processes (deep draw, cold forge, shear form, and powder metallurgy) coupled with achievable fabrication accuracy and precision on munition performance.

c. Completed the development of the jet/overburden/mine interaction analytical model.

d. Completed the evaluation of alternate explosives (Comp A-3 (II), PBXN-6, PBX-0280 PE, PBX 9407, and PBX 9205) on charge performance.

e. Transitioned an improved AMM concept for future system development.

Planned Work

The applied research work for the DET task will build upon and expand the DET base gained from the previous year's work. Following is a brief description of the work planned for FY97.

a. Prepare the final report on the Precision Initiation task.

b. Prepare the final report on the Alternate Explosive task (part of the overall Effect of Liner Manufacturing Process).

c. Complete and prepare a final report on the characterization of the effects of total warhead and array construction tolerances to performance.

d. Complete and prepare a final report on the characterization of global explosive array initiation.

e. Complete and prepare a final report on the modeling of array configuration options.

Projected accomplishments for execution in FY97 follow.

a. Completion of the final reports for the Precision Initiation and the Alternate Explosives tasks.

b. Characterization of the array configuration.

c. Characterization of the array initiation.

d. Completion of a final report detailing all of the tasks conducted under the DET program.

Transition plan

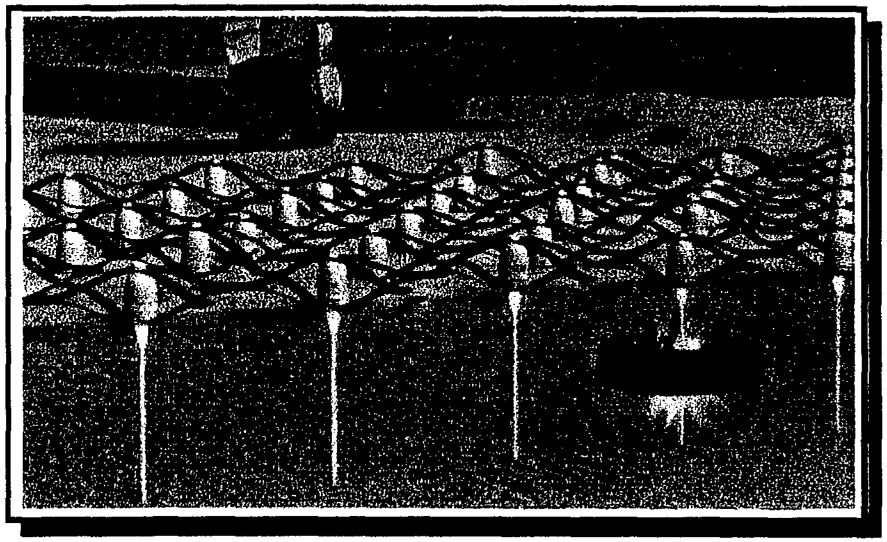
All transitions of DET for land related concepts will be to PE 63640M, Marine Corps ATD; 63612M, Marine Corps Mine/Countermeasures Systems (Advanced); and, the US Army's Standoff Minefield Breacher program, PE 0603606A/0603619A. All technology in this task having applicability in water will transfer to the Navy Shallow Water Mine Countermeasures Program, PE 0603502N. The milestone chart shows specific transitions.

Relationship to Other Programs

This task provides a basis for a planned DET ATD supporting the Navy Shallow Water Mine Countermeasures Program. A joint-service USMC/Army technical working group is

established by a MOA and meets regularly to discuss program status and advances made in explosive neutralization. Negotiations are underway to establish a Joint Explosives Program.

DISTRIBUTED EXPLOSIVE TECHNOLOGY



OBJECTIVE:

- PROVIDE TECHNOLOGIES TO NEUTRALIZE CURRENT AND FUTURE LANDMINES, REGARDLESS OF FUZING OR TYPE IN ALL OPERATIONAL ENVIRONMENTS

CAPABILITIES:

- S&T ROUNDTABLE NEEDS:
  - IN-STRIDE OBSTACLE BREACHING WHILE UNDER FIRE (R-Q1)
- SHALLOW WATER MINE COUNTERMEASURE ORD
- ASSAULT COUNTERMINE WARFARE MNS

APPROACH:

- DEVELOP DISTRIBUTED EXPLOSIVES TO MAXIMIZE MINE KILL CAPABILITY AND MINIMIZE LOGISTICAL BURDAN/HAZARD TO OPERATOR
- DEVELOP MINE KILL MECHANISM USING SHAPED CHARGE TECHNOLOGY FOR INTEGRATION TO MULTIPLE DEPLOYMENT SYSTEMS
- IDENTIFY MANUFACTURING PROCESSES FOR MINE KILL EFFECT TOLERANCE VS AFFORDABILITY TRADE-OFFS
- DEMONSTRATE MINE KILLS TO 5 IN SOIL OVERBURDEN AND 30 IN AIR STANDOFF

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
MINE KILL TESTING	▲——▲			
ACCURACY TESTING	▲——	——△		
ARRAY CONFIGURE		△——△		
TRANSITION		△	△	

PERFORMERS:

- NSWC/IH, TRACOR AEROSPACE

TRANSITION:

- PM-SSE, ARMY PM-MCD, NAVY PMO-407

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 5. ANTI-HELICOPTER MINE COUNTERMEASURES

Problem/Deficiency

Future helicopter air defense will become increasingly more difficult to achieve due to advances in target sensing technology and warhead design. This advanced threat can be classified as an electronically "smart" mine, capable of detecting, classifying, and targeting airborne combat vehicles from distances outside of conventional mine ranges. AHMs attack low flying helicopters. The technical problem addressed in this project is the autonomous neutralization/destruction of advanced AHM surface to air threats from distances greater than the mine attack capabilities.

The AHM is a threat mine system employing combinations of sensor systems which may include acoustic, IR, and MMW. The ground sensor package (GSP) of these mines will detect, classify, and track potential target helicopters. The GSP will determine whether or not to fire Multiple Explosively-Formed Projectiles (MEFPs) or other kill mechanisms at the target.

Technical Objective/Expected Payoffs

The overall objective will be to develop base technologies for countering AHM systems of the future. The three underlying tenets of the program are:

a. The threat will be a surface deployed advanced technology standoff mine targeted for helicopter signatures.

b. The sensor systems will employ acoustic, seismic, IR, and/or MMW sensor technologies to detect, track, and target high value assets; and

c. The defeat of the AHM GSP may involve offensive detection, neutralization, clearance, or direct attack.

At this point, the countermeasures platform must be outside of lethal range of the AHM or be capable of defeating/evading the terminal sensor system of the threat mine warhead.

This task develops concepts and technologies to enable operational forces to conduct high-speed, continuous, and effective surface to air missions against the advanced stand off/wide area mine threat during both amphibious and land/air combat operations. This supports emerging doctrines of maneuver warfare and OMFTS, yielding far term pay offs.

Technical Background and Approach

There are numerous technological innovations available to designers of AHMs which give mine warfare a quantum leap of capability. Countermeasures in this area have not kept pace with technology. Though no true surface to air standoff threats have been fielded to date, analysis of the technologies, components, and subsystems being utilized in ongoing US and foreign developmental efforts will allow conceptualized countermeasures devices and procedures for these emerging mining systems to be developed. Baseline mine developments include the Ferranti-Alliant Techsystems Inc. AHM and the Austrian Helkir AHM by Hirtenberger. Using these baselines, technology countermeasures can be projected.

Presently, first generation AHM systems present a threat for which there is no countermeasure. If we are to meet the challenge of AHMs, we must invest now in technology that will support engineering development and rapid transition to fielded autonomous air defense systems in the future.

These advanced mines will sense particular features of target signatures. Implementation of countermeasures such as target signature suppression, modification, or projection as techniques of defeating/attacking their sensor systems will all be considered. The focus of this task will be research into countermeasures techniques for following the acoustic, seismic, IR, millimeter, and magnetic sensors of future AHM threats. Emphasis will be placed on M&S techniques to experiment with AHMCM before hardware development. M&S will also be used for countermeasures predictive effectiveness and for subsequent hardware system definition. UAV technologies will be investigated as candidate countermeasure platforms.

Summary of Prior and Current Years' Work

a. Performed a threat characterization of AHMs.

b. Completed development of surrogate threat AHM sensor platform.

c. Identified and ranked all possible AHMCM techniques.

d. Began development of a one-on-one physics based model of AHM and helicopter encounters. Contractor determined best operational parameters for each highly ranked countermeasure technique identified.

e. Continued CASTFOREM force on force modeling and simulation effort with TRADOC Analysis Center - White Sands Missile Range (TRAC-WSMR).

f. Coordinated efforts with the "user" community via Air Defense Artillery School, Fort Bliss TX and Comanche PMO, Comanche Helicopter Test Integration Working Group (TIWG).

Planned Work

Due to funding constraints in the upcoming fiscal years, the AHMCM program has been put on hold.

Planned Transitions

The AHMCM effort is planned to transition into ATD, PE 63640M, in FY98.

Relationship to Other Programs

Efforts within the Technical Base developments of the Navy's Applied Research Block XDIA, Tactical Directed Energy, Project Number XA11P20, being managed by the Navy Research Laboratory (NRL), Washington, DC. The following Independent Research and Development (IR&D) programs are being reviewed to define their relationships to the planned efforts within this efforts.

a. Helicopter Identification by Acoustic Techniques, Ferranti Technologies, Manchester, England.

b. Advanced Sensor Testbed, Project Number D0920, Alliant Techsystems, Precision Armament Systems, Minnetonka, MN.

c. Smart Mine - Air Acoustics, Project Number D0920, Alliant Techsystems, Precision Armament Systems, Minnetonka, MN.

d. Directed Energy, Project Number D0920, Alliant Techsystems, Precision Armament Systems, Minnetonka, MN.

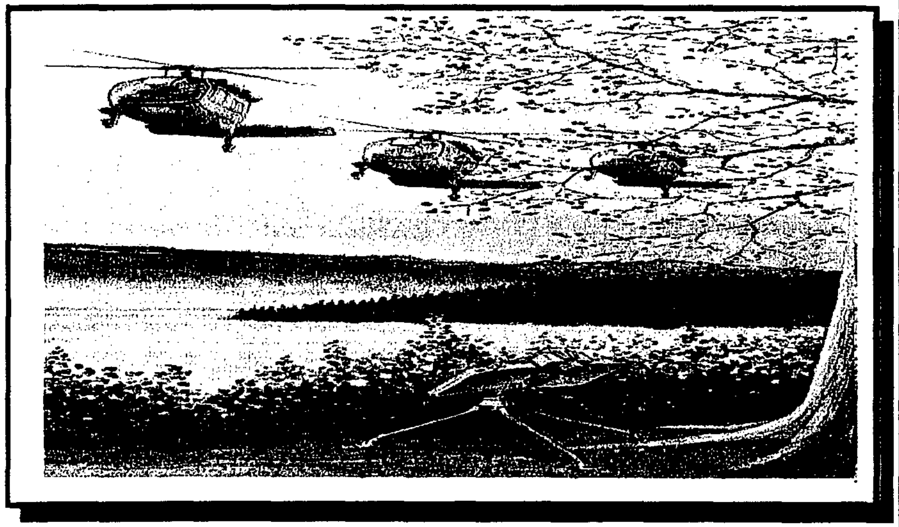
e. Scatterable Mines C2, Project Number D0830, Alliant Techsystems, Precision Armament Systems, Minnetonka, MN.

f. Advanced Signature/Vulnerability Evaluation, Project Number AS-91-10, Bell Helicopter Textron, Inc., Fort Worth, TX.

DARPA is sponsoring research into technologies applicable to Off-Route Smart Mines (ORSMs). The US Army ARDEC, Picatinny Arsenal, NJ, is currently monitoring two competing AHM design concepts. These programs will be monitored through working groups/meetings for data or other findings which are applicable to this task. A joint USMC/US Army program will be pursued.

THIS PAGE INTENTIONALLY LEFT BLANK.

ANTI-HELICOPTER MINE COUNTERMEASURES



OBJECTIVE:

- DEVELOP TECHNOLOGIES AND CONCEPTS TO NEUTRALIZE CURRENT AND FUTURE ANTI-HELICOPTER MINES IN ALL ENVIRONMENTS AND OPERATIONAL SCENARIOS
- NEUTRALIZE WITH MINIMUM HAZARD TO OPERATOR & INSTRIDE WITH COMBAT OPS

CAPABILITIES:

- INCREASED SURVIVABILITY TO MAGTF FORCES DURING HELIBORNE ASSAULT
- INCREASED CAPABILITY FOR AIR SCOUT-RECON MISSION

APPROACH

- DEVELOP THREAT TECHNICAL ANALYSIS
- DEVELOP ACTIVE COUNTERMEASURES BY SIMULATION OF SMART MINE ACQUISITION AND TRACKING SIGNATURES
- INVESTIGATE USE OF LOW OBSERVABLES TECHNOLOGY FOR PLATFORM SURVIVABILITY
- FABRICATE, TEST & DEMO

PERFORMERS:

- BRDEC, FORT BELVOIR
- SANDIA NATIONAL LABORATORIES
- WATERWAYS EXPERIMENT STATION
- PENN STATE UNIVERSITY ACOUSTIC RESEARCH LAB

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
THREAT ANALYSIS	▲—▲			
FORCE ON FORCE M&S	▲———▲			
DOCUMENTATION		△—△		

TRANSITION:

- PM-SSE, ARMY PM-MCD, NAVY PMO-407

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 6. VEHICLE LANDMINE SURVIVABILITY

Problem/Deficiency

One of the most common and destructive weapons that faces the MAGTF today and in the future is the landmine. This threat has increased in numbers, availability, and sophistication, providing a combat multiplier for the threat. Soviet surrogate and non-aligned nations are purchasing large numbers and types of mines with a low cost and high pay-off in combat. Operations Other Than War (OOTW) offer many opportunities for the employment of conventional land mines and surprise firing devices. Proliferation of these weapons can be expected to increase. The most logical targets of these mines are unprotected/ lightly protected vehicles traversing known routes within the combat and rear areas. In World War II, 33 percent of all vehicle losses were attributed to landmines. That figure rose to 69 percent during the Vietnam conflict. In recent world conflicts of low and mid-intensity, an even larger percentage of casualties were attributable to landmines. Likely areas of future MAGTF employment will certainly include areas of heavy landmine threats. Such threats will impede combat capability if not threaten the mission itself. While detection of mines and mine breaching is a necessary combat capability, present and future sophistication and employment options make mines a constant threat. No current Marine Corps vehicles, except those with heavy armor, are capable of surviving or protecting occupants from an anti-tank mine blast. Development of vehicle design technology that will significantly improve survivability of equipment and personnel in the landmine dense environment is needed.

Technical Objectives/Expected Payoffs

The payoff for this task will be the sustainment of combat power provided by the survivability of personnel, vehicles, and equipment in a landmine intense environment. Such protected vehicles may act in a pure transportation role as well as tactical escort, mine detection, and mine neutralization system deployment. This technology will benefit all Army, Navy, and Air Force Tactical Vehicle Fleets. This task supports Mission Area 22 - Ground Tactical Mobility/Counter-Mobility and Mission Area 43 - Transportation.

Technical Background and Approach

Several countries involved in low-intensity conflicts within the last twenty years have developed combat proven technology for mine-blast resistance/protection for vehicles. While such vehicles allow for personnel to survive mine blasts and provide for minimum damage to the affected vehicle, the technology level of today's fielded systems is relatively primitive and immature. The thrust of this task will be to develop improvements in design and materials technology to allow for improved mine blast protection of present and future Marine Corps tactical vehicles. The focus of this task is a holistic approach toward vehicle design,

components, and materials technology. The task will take advantage of new and emerging technologies in armor concepts.

The technical approach is to analyze the mechanics and quantify the parameters, of blast damage to vehicles from mine encounters, as well as physical injury to occupants. This will be done through modeling and field testing of surrogate equipment and personnel targets. This includes computer analysis of explosive blast characteristics and effects against equipment as well as personnel injury analysis. The information gained will provide the basis for follow-on blast survivability testing of other vehicles.

Summary of Prior and Current Years' Work

a. Completed a deficiencies and requirements analysis through modeling and field testing. Correlated blast effects with equipment damage and personnel injury.

b. Completed extensive modeling/analysis of baseline vehicle - blast/structural interaction.

c. Completed verification of predictive blast pressure/impulse for computer models.

d. Completed development baseline of computer model of physiological effects following a landmine detonation. Incorporated acceleration type injuries to DoD Operational Requirements-base Casualty Assessment. Evaluated effects of blast pressure on human lungs/heart.

e. Continued design and engineering of vehicle blast survivability enhancements. Modeled improvements for predicted effects and verified predictions with full-scale field tests.

f. Initiated follow-on candidate materials survey. Materials evaluation based on strength, weight, energy absorption and cost.

g. Conducted field tests of prototype mine protection kit for HMMWV.

h. Transitioned design of mine protection blast deflectors to Army TACOM. Kits were produced for troops in Bosnia.

Planned Work

In FY97, the following work is planned.

a. Develop final report on project.

b. Develop report outlining all computer modeling efforts.

c. Participate in international forum on protection of wheeled vehicle occupants from landmine effects.

d. Complete Transition Documentation.

Transition Plan

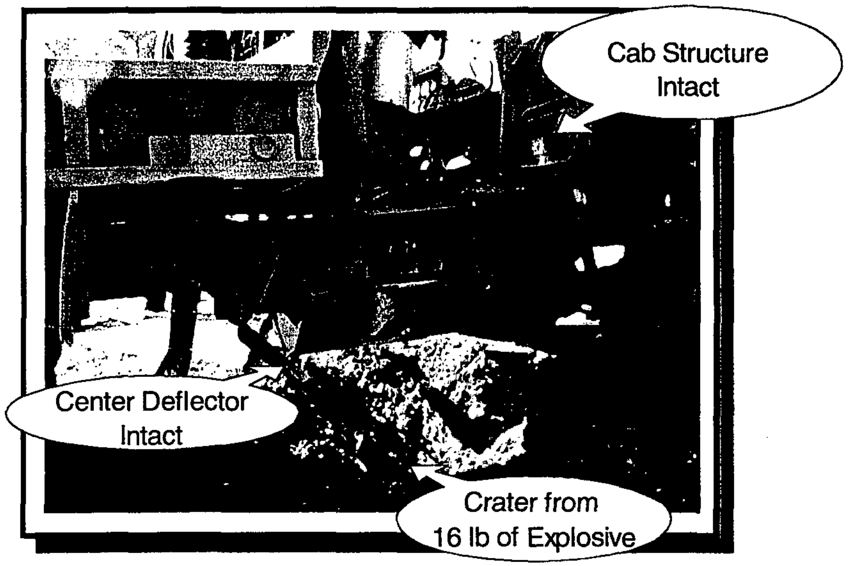
This technology will transition to USMC PM, CSS for a PPPI of the Medium Tactical Vehicle fleet (PE 26624M). In addition, the survivability enhancement technology will be transitioned to the Program Executive Office (PEO), Combat Support Vehicles and the TACOM.

Relationship to Other Programs

This project is related to the Marine Corps 6.2 effort's MAGTF Survivability Technology (CF31U10), Advanced Armor Technology (Task 4), and PE 26624M, Project Number C0076M for CSS Medium Tactical Vehicle fleet. A joint technology effort and follow-on effort with the US Army is being pursued.

THIS PAGE INTENTIONALLY LEFT BLANK.

VEHICLE LANDMINE SURVIVABILITY



OBJECTIVE:

- PROVIDE TECHNOLOGIES TO PROTECT VEHICLES AND OCCUPANTS FROM EFFECTS OF LANDMINES AND EXPLOSIVE BLAST WEAPONS

CAPABILITIES:

- S&T ROUNDTABLE NEEDS
  - VEHICLE STRUCTURE SURVIVABLE TO BLAST/KINETIC PENETRATION (R-Q1)
  - TACTICAL VEHICLE FLEET MNS
  - ADDRESS MAAs FOR CLOSE COMBAT AND TRANSPORTATION
  - CONTINGENCY ITEM TO DEPLOYED FORCES

APPROACH:

- TRANSITION OF TECHNOLOGY AND CAPABILITY TO LIGHT STRIKE VEHICLE, FLCV, RST-V ATD, TACTICAL VEHICLE REBUY AND REBUILD PROGRAMS
- PROVIDE ANALYSIS, MODELING, DESIGN SUPPORT FOR VEHICLE AND INTEGRATION EFFORTS:
  - BASELINE TESTING OF STRUCTURAL BLAST EFFECTS
  - MODEL VERIFICATION TESTING (INCL PHYSIOLOGICAL EFFECT)
  - INCORPORATION ON FMF AND ARMY ASSETS
- JOINT PROGRAM WITH DARPA, US ARMY

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
FABRICATION	▲▲			
BASELINE TESTS	▲	△		
MODEL VERIFICATION	▲	△		
TRANSITION		△△		
BOSNIA SUPPORT	▲▲			

PERFORMERS:

- ARMY CECOM - NIGHT VISION LAB

TRANSITION:

- PM - CSS, US ARMY TACOM

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 7. ADVANCED BREACHING TECHNOLOGIES

Problem/Deficiency

The emerging OMFTS doctrine outlines the overwhelming need for technologies and techniques to enhance maneuverability. The Marine Corps Combat Development Command, Mission Area Analysis, Mission Area 44, Expeditionary Engineering, identifies the need for research and development in the area of mine countermeasures. Mission Area 22, Ground Tactical Mobility/Counter Mobility, also states that in order to maintain mobility for counter maneuver, rapid breaching of minefields is required. The primary targets of concern in MCM are the countermeasures hardened anti-tank mines. These mines are becoming more sophisticated with the addition of electronic sensors that will allow deeper burial and less susceptibility to countermeasures.

A recent unique threat for MCM is the Wide Area Mine (WAM). The WAM is deployed onto the ground and autonomously searches for target vehicles from a standoff distance. When the acoustic sensors aboard the WAM detect a vehicle, a seismic sensor "wakes-up" and launches a smart submunition. This is all done off route and the WAM will not be effected by current mine breaching technologies. As scatterable and WAM mine fields become more prevalent, it will be essential to acquire and neutralize mines on an individual basis. New methods for precision neutralization of these advanced mine threats are needed.

Technical Objective/Expected Payoffs

Mine Hunter-Killer. This task leverages the technology and development efforts ongoing in the Navy Explosive Ordnance Technology Division project "Basic Unexploded Ordnance Gathering System (BUGS)." The current focus of this task is to develop a small, simple, low cost, robotic system to conduct minefield/obstacle breaching and large area mine/obstacle clearance. The application of small robotics and distributed processing will decrease the resources and time needed to perform minefield breaching and clearance while extending standoff distances for tactical minefield breaching operations.

Advanced Vehicle Breaching Technology. As new doctrine and equipment are fielded into the Marine Corps, the philosophy of MCM must change as the threat of mine warfare becomes more diverse and more common. The current MCM systems are large mechanical systems on slow moving platforms or heavy high explosive systems carried in or towed behind combat vehicles. The Marine Corps is moving towards a lighter and quicker force not capable of sustaining high tempo/high logistical burden advances. This task will develop technologies combined with techniques of employment to ensure that the future MCM capabilities will flow from the premise of maneuver warfare.

Technical Background and Approach

Mine Hunter-Killer. Through the use of distributed architecture systems, simple goal oriented tasks can be accomplished by affordable, disposable robotic systems. Working in conjunction with detection information from any source (other robots, airborne systems, etc.) these small robotic systems can be applied to a wide range of DoD missions including MCM. Research work performed at universities and institutions in the areas of control, propulsion, navigation and sensors is now ready for development into technologies that can support DoD applications. Multiple, low cost, autonomous robotic systems using subsumptive and group behavior control technologies can be applied to both traditional and WAM minefields by individually targeting each mine with an improved AMM.

This task will investigate mine acquisition/targeting sensors, control methodology for MCM missions, extend existing modeling work to include MCM missions and integrate current explosive mine neutralization technology for kill mechanism.

1. Sensor. A sensor on the hunter-killer platform is necessary to detect and locate the target after initial guidance from external sources. The error inherent in both the external and internal location and targeting systems will drive the control methodology selected and will be the basis for computer modeling. This error will also drive the accuracy needed for the AMM. The sensor approach for MCM applications is driven by the inherent error in targeting data and the allowed false alarm rate for a system approach. Precision neutralization of WAMs will require the extension of Electronic Safed and Fuzed Fuze (ESAF) detection technology developed under the EOD Technology Applied Research Program. Standoff detection and discrimination capabilities must be established and used in the model based simulation to accurately determine the application of the hunter-killer concept for WAM clearance.

2. Controller. Small, autonomous vehicles can be controlled with a data driven, task prioritized architecture using subsumptive algorithms. These algorithms are used extensively in robotics to control simple movements and tasks that would otherwise overwhelm the higher architecture controller's processing power. The primary attribute of a subsumptive control is that response and motion behaviors are given to the vehicle and triggered by sensory perceptions in a data driven manner. That is, behaviors are decided based on the application of rules to data collected by sensors. Behavior priorities are used for conflict resolution, such as encountering an object stops motion. Control decision logic is therefore based on a forward chaining search over the rule base, as opposed to a backward chaining goal driven search as favored in most autonomous vehicle applications.

3. Neutralization. The USMC, under the DET task, has developed a mine neutralization charge, the AMM, capable of defeating all mine types regardless of fuze type. The Mine Hunter-Killer platform will carry, employ, and initiate these charges autonomously when a positive mine identification has been made. The neutralizing charge must be small and lightweight so the platform can carry it without performance degradation. The carrying capability of the platform will allow the existing AMM to increase in size and weight and a trade off analysis and modeling will be undertaken to maximize the effectiveness of the AMM

technology. The neutralizing charge will have a remote electronic initiation fuzing mechanism with safety measures and a capability of initiating multiple charges simultaneously. A trade off analysis will determine the optimum size and weight for various mission capabilities. Further improvement of the existing AMM for performance as well as integration will be done for this system.

4. Modeling and Simulation. The most cost-effective way to explore this technology is through the use of a model based graphics simulator. The simulator can be used to study the influence of differing conditions such as ordnance type and density, terrain type and environment, vehicle control logic, sensor suites and target types.

Modeling of the external mine detection data will be based on the capabilities of the USMC COBRA minefield detection system and the US Army ASTAMIDS. Data from the COBRA and ASTAMIDS systems will be relayed to the Hunter-Killer for the location of the minefield. The Hunter-Killer will use the data to search for, re-acquire, and neutralize mines.

5. Test Bed. The test bed vehicles for this work are based on vehicle technologies developed for the NASA Mars Rover Project and for Shallow Water Mine Countermeasure work performed by DARPA. Leveraging this work reduces time and cost for demonstrating five different test bed vehicles for this application. Two wheeled, two tracked, and one walking test bed have been demonstrated in a proof of principle test early in this task.

Advanced Vehicle Breaching Technology. By the year 2010, mine warfare will changed drastically due to the highly sophisticated threat, the need to provide mobility and survivability, and the emergence of real time aerial mine detection. Mine warfare can no longer be looked upon as the add-on piece of equipment. Integration of doctrine, equipment, and technology is crucial to maintaining battlefield dominance. This effort will investigate technology solutions capable providing the greatest impact to the Marine Corps.

Summary of Prior And Current Years' Work

Mine Hunter-Killer. Selected four contractors via the BAA process to participate in the initial phase of the project. Each of these contractors (Draper Labs, Foster-Miller, ISX, K^2T) have developed or are developing small robots on other government contracts. These robots served as test beds for control systems specifically designed for the MCM mission.

Conducted test series that was designed to exercise and evaluate the platform control systems. These tests, along with the computer modeling/simulations and technology concept studies, were used to select the most promising concept for further development.

Conducted Proof-of-Concept demonstration with the four contractor and one in-house platform demonstrators.

Initiated modeling and simulation effort of multiple scenarios with all contractor concepts. The simulation will be used by all aspects of the Hunter-Killer program to help define requirements, design criteria and predict performance.

Investigated a wide range of academic, corporate and government agencies that work in the area of robotics in order to ascertain the proper approach for this effort.

Investigated a remote command and initiation system for the Hunter-Killer munition. A prototype was designed and manufactured. An inert munition was made for the test bed testing and proof-of-concept demonstration. An evaluation of Safe & Arm requirements and options for the munition begun.

Advanced Vehicle Breaching Technology. This sub-task is new for FY97.

Planned Work

Mine Hunter-Killer. Due to funding constraints, this task has been suspended for one fiscal year. When the program is resumed the Mine Hunter-Killer concept will be expanded to focus on a group of vehicles working in unison. A demonstration of a multiple agent system will be held, showing how it can perform the MCM mission. Sensors for mine detection will continue to be investigated, and the threat assessment will be expanded upon. The AMM will be fabricated and tested.

Advanced Vehicle Breaching Technology. This task will investigate technologies capable of use on future USMC vehicles. Technologies in the areas of mechanical, explosive and electromagnetic countermeasures will be analyzed as individual or integrated system solutions to the MCM problem facing the USMC in the next century.

Transition Plan

Mine Hunter-Killer. This technology will transition to a Marine Corps ATD program (PE 0603640M) in FY00. This technology will also be transitioned to the Joint EOD/Low Intensity Conflict (LIC) ATD in FY97 as well as be reviewed by the Joint Service Unmanned Ground Vehicle (UGV) program.

Relationship to Other Programs

Mine Hunter-Killer. This task supports a conventional Joint Service EOD need that supports all four services.

This work supports the Joint Service Program Plan (JSPP) for the Technology Panel for Conventional Air/Surface Weaponry (CASW), Warheads and Explosives Subpanel. The EOD

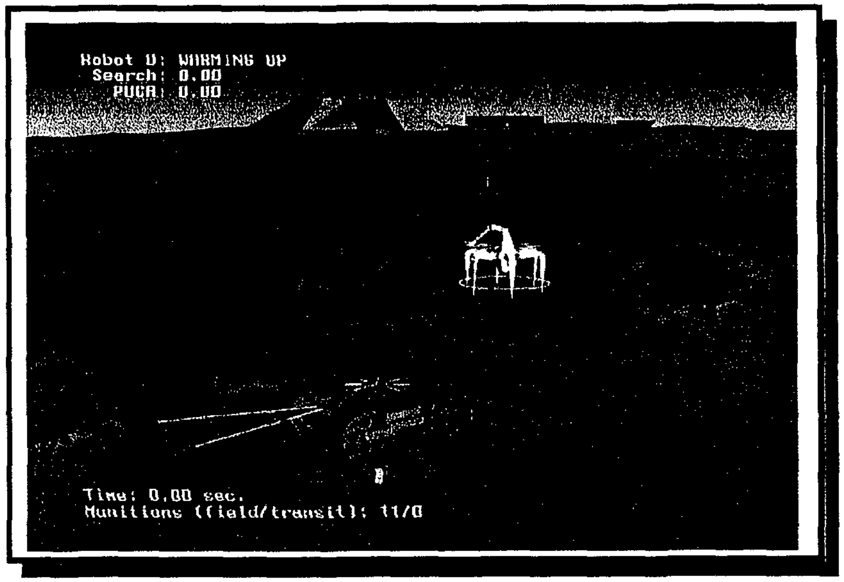
Technology Sub-Sub Panel is recognized as a Category 4 (Consolidated) program with the Navy as the lead service. All work in the EOD Technology Program Area is reflected in the CASW-JSPP.

DARPA has funded the first phase of an SBIR with Foster-Miller Corporation to develop small vehicles for explosive neutralization of shallow water mines in the surf-zone. Grumman has also proposed the use of small subsumptive vehicles for use on the battlefield.

Other Navy funded, either in-part or wholly, programs include academia work in locomotion control technologies. The Case Western Reserve University is developing neural control architecture for stable locomotion and rapid turning in a hexapod robot on rough or inclined terrain. Marshall University is investigating how sensor information from mechanoreceptors is used to adapt locomotion during normal and perturbed walking. University of California/Berkeley is analyzing the biomechanics of legged locomotion in invertebrates, including obstacle negotiation, turning, and response to perturbation. Massachusetts Institute of Technology is developing the design and control of animal-like robot legs in agile, high speed locomotion. California Technical University is analyzing central pattern generator and leg reflex circuits for hexapod locomotion. University of California/San Diego is developing large scale realistic models of central pattern generators with a large repertoire of motor patterns. Jet Propulsion Laboratories is developing new legged vehicle control approaches based on tracking oscillating and bifurcating trajectories of coupled central pattern generators. K2T Incorporated is developing walking machines for shallow underwater operations. Massa Products Corporation is developing legged vehicle for underwater mobile operations.

THIS PAGE INTENTIONALLY LEFT BLANK.

ADVANCED BREACHING TECHNOLOGIES



OBJECTIVE:

- SUPPORT OMFTS CONCEPT BY DEVELOPING TECHNOLOGIES TO CLEAR LANDMINES AND OBSTACLES PROVIDING ENHANCED MOBILITY AND SURVIVABILITY IN A MINED LITTORAL ENVIRONMENT

CAPABILITIES:

- S&T ROUNDTABLE NEEDS:
  - INSTRIDE OBSTACLE BREACHING WHILE UNDER FIRE (R-Q1)
- SHALLOW WATER MINE COUNTERMEASURES MNS
- RAPID FOLLOW-ON MUNITIONS CLEARANCE CAPABILITY MNS

APPROACH:

- INVESTIGATE SUBSUMPTIVE ARCHITECTURE, AUTONOMOUS MINE COUNTERMEASURE CAPABILITY
- DEVELOP COOPERATIVE INTELLIGENCE FOR MULTIPLE PLATFORM MISSION CAPABILITY
- DEVELOP OBSTACLE REDUCTION WARHEAD
- INTEGRATE NON-METALLIC MINE DETECTION AND MINE COUNTERMEASURE CAPABILITIES
- DEVELOP SYSTEM LEVEL MODELING AND SIMULATION INCLUDING C4I INTERFACE
- LEVERAGE EOD TESTBED

PERFORMERS:

- EOD TECH CEN, NSWC/IH,NAVAL POST GRAD SCH, NSWC/CARDEROCK

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
TESTBED DEV	▲	△		
M&S DEV	▲	△		
WARHEAD DEV		△		△
INTEL ARCH DEV		△		△
TRANSITION				△

TRANSITION:

- ARMY MINE HUNTER KILLER ATD

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 8. DETECTION/ACQUISITION AVOIDANCE TECHNOLOGIES

Problem/Deficiency

Tactical deception and signature management are major factors with regard to the Marine Corps' need for an amphibious capability supporting OMFTS. In addition, the Sea Dragon concept requires capabilities for small task forces spread out on the battlefield. To enhance these operations camouflage, concealment, and deception (CCD) technologies are required to minimize the vulnerability of vehicles and other systems to the myriad of sensing mechanisms used by the enemy during amphibious assaults, as well as during operations inland. Signature management within the electromagnetic spectrum, tactical deception technologies, and reduction of dust generation are key areas to be explored to minimize the detectability of a vehicle by enemy sensors. This task addresses applicable methodologies for accomplishing reductions in detection and acquisition of Marine Corps combat and tactical vehicles.

Technical Objective/Expected Payoffs

Current Navy/Marine Corps amphibious assault capabilities bring valuable Navy assets close to the hostile beach. Projected amphibious assault tactics will involve the use of the AAAV which will allow Navy ships to stand-off further from the shore. However, both today's and tomorrow's tactics will require the use of Detection and Acquisition Avoidance technologies to reduce detectability and enhance tactical surprise. This task will address the technologies to enable tactical surprise that can be integrated into a vehicle system to minimize the detectability of the vehicle by the wide range of enemy devices. The payoff will be tactically superior and cost effective combat vehicles. The aim will be to produce a vehicle system design that optimizes the interaction between the vehicle mission system equipment and applicable technology design. Through the use of detection/avoidance technologies, the Marine Corps will reduce vulnerability to enemy sensors. Development of lightweight technologies, that can survive the marine environment, will provide the capability to maneuver in and out of the water, as well as, the ability to quickly change a camouflage system from a water environment to an inland environment.

Technical Background and Approach

This task will capitalize on the achievements of US Army CCD efforts for ground vehicles to address the technologies applicable to USMC vehicles. Ongoing classified and unclassified efforts will be monitored and when appropriate this task will adapt a technology to a particular platform and survivability suite. One particular approach is to apply tactical decals to the hulls of USMC platforms such that signature suppression in the visual and IR spectrum or the spectrum of choice for that particular platform against side and top attack viewing angles is possible. The decals will significantly reduce "hot spot" areas. Technologies for electronic deception are slowly being developed, however, none have been optimized for amphibious

operations. The tactical decal approach is a self-contained applique decal approach to provide vehicles the ability to retain mobility in a state of reduced signature with enhanced survivability.

Summary of Current Year's Work

Design, development, and application of tactical decals was started in FY94 and completed in FY96. The decals were applied to the PSD for suppression of the visual and IR signatures. The decals were applied via a canvas like material that had a land-based design on one side and a water based design on the other. The two sided material has the water decal up during water operations and once inland the decal is flipped to expose the land decal. This approach is uniquely applicable to assault vehicles and has application for other USMC platforms as well. The focus was application of the decals to the PSD for signature suppression and, in addition, the effort has been the first to conduct a thermal analysis of a composite vehicle under solar loading conditions as well as extended operating conditions.

Planned Work

Work in the lightweight appliques area will continue to develop new signature reducing technologies for USMC vehicles. This will be accomplished through ongoing contracts and new start contracts to be awarded in FY97 from proposals submitted to a USMC BAA solicitation. This task will also work closely with the US Army CCD group to be fully aware of ongoing efforts and capitalize on promising technologies.

Transition Plan

All detection and acquisition avoidance technologies will be transitioned into appropriate USMC programs as dictated by doctrine and requirements. The appropriate PMs will then incorporate hardware developed under these tasks. The appropriate technology will also transition into the RSV and FLCV ATD programs under Maneuver Imperative: Surface Mobility. This technology is expected to transition in the mid to long-term.

Relationship to Other Programs

Detection and Acquisition Avoidance technologies are being pursued by the Army. This work is being monitored for Marine Corps application. Ongoing Army work in lightweight CCD will be monitored for potential joint funding and application.

SEE TASK 9. INTEGRATED SURVIVABILITY, QUAD CHART
AS IT APPLIES TO BOTH TASKS 8 AND 9.

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 9. HIT/KILL AVOIDANCE

Problem/Deficiency

There is a continued proliferation of "smart" weapons throughout the world. These potential threat munitions incorporate sensor technology to assure greater probability of hit of enemy platforms. In addition, the penetrator technology available today is more lethal than when many USMC platforms were fielded in the past 20 years. In addition, the USMC has two unique problems related to their vehicles. First, the vehicle must operate on the open ocean and through the surf which demands a very low weight. Second, particular care needs to be paid to corrosion because of the salt water environment. Efforts within the USMC for Hit Avoidance technologies have yet to be established. Various Army efforts are ongoing and will be monitored for USMC application.

Technical Objective/Expected Payoffs

A coordinated USMC lightweight armor program has been established and will continue to provide a centralized resource for both current and future Marine Corps vehicle needs. It also provides for inter-service coordination via the Combined Light Armor Survivability Panel (CLASP) to minimize or eliminate duplication of effort resulting in the potential for significant cost savings with the possibility for cost sharing. Armor efforts for defeating both kinetic energy (KE) and chemical energy (CE) threats concentrate on providing increased capability against larger threats while maintaining system viability for vehicle adaptation. Improved mass and space efficiencies, as well as cost projections, are the measures of merit to evaluate new and emerging armor systems with at least 20-percent improvement as the goal. This task is expected to produce transitionable results in both the near and midterm periods. In the area of Hit Avoidance Technologies, an affordable system capable of countering sensor aided threats will be the primary objective. These technologies will not be considered as stand-alone systems but rather as part of an integrated survivability suite. These technology areas will be pursued with intentions to fit in with the objective of Task 10 Integrated Survivability/Special Programs.

Technical Background and Approach

The technical approach requires proper coordination of armor upgrade efforts among the Army and Marine Corps Project Offices as well as just within the USMC. Due to the rise in activity to increase ballistic protection of fielded vehicles for the Army and the USMC, proper coordination is needed with Industry and Government Laboratories to insure that the most promising applique and future stand-alone systems are appropriately evaluated. In addition, tomorrow's threat will be a smarter threat with on-board guidance system capabilities. This is especially true for top attack threats. With the growth in "smart munitions" it is increasingly more obvious that armor designs would be more advantageous if they were designed with signature alteration characteristics built in. Past approaches to survivability enhancement of a

combat system have simply added armor. Tomorrow's battlefield, along with a need to reduce combat vehicle weight, is leading survivability technology towards "Survivability Systems" vs. "More Armor".

As the central source for armor development within the USMC and Principal Development Activity (PDA), this task is supporting the National Armor Data Repository (NADR), which is the collection of armor/anti-armor evaluation data conducted by the Air Force, Army and DARPA. Semi-annual meetings for the NADR working group are held for updates on available data. In addition, the CLASP is now chaired by the USMC and holds semi-annual meetings for Government discussion of ongoing armor development programs. In attendance are various Army, Air Force, and USMC PMs.

Hit Avoidance Technologies will be monitored in FY97 with the potential for incorporating within an integrated survivability suite starting in FY98.

Summary of Prior and Current Years' Work

This program conducted a design, fabrication, and test of a modular armor kit (MAK) for application to a AAAV platform. The requirement was for 30 milli-meter (mm) Armor Piercing Discarding Sabot (APDS) protection, however, this effort also addressed the small, shaped charge threat. Tests were conducted in the summer of FY96 and the results are expected in early FY97. The effort included 6 targets (3 high risk and 3 medium to low risk). Another approach utilizing advanced armor technology to the AAAV focused on top attack protection. That effort has transitioned into an Army program to develop, fabricate and test the AAAV design over the next two years. A continuing effort started in FY94 in Advanced CERMET materials evaluated a single CERMET on a backing material against fragmentation threats simulated using the 20mm Fragment Simulating Projectile (FSP) for application to USMC vehicles.

Planned Work

Kill Avoidance. This effort will include chairing and participating in the CLASP and continued monitoring of applicable Government and Industry armor activities. It will also provide joint support of a lightweight armor database, including consultation with NADR users. Promising new armor materials will be evaluated by firing appropriate, projective, and subsequent evaluation. This effort will benefit from a planned MOA with the Army for light armor development. The primary focus of the MOA is to determine the responsibilities of the participating parties as well as the investigation of Low Observable Armor (LO-Armor) concepts.

Hit Avoidance. This effort is a new start effort in FY97 and will encompass monitoring ongoing US Army programs for potential application into Task 10 as well as adapting systems that exist to work on a USMC platform. Any new technologies in this area will be developed under this task and eventually, given successful results, transitioned into Task 10 as applicable.

Planned Transitions

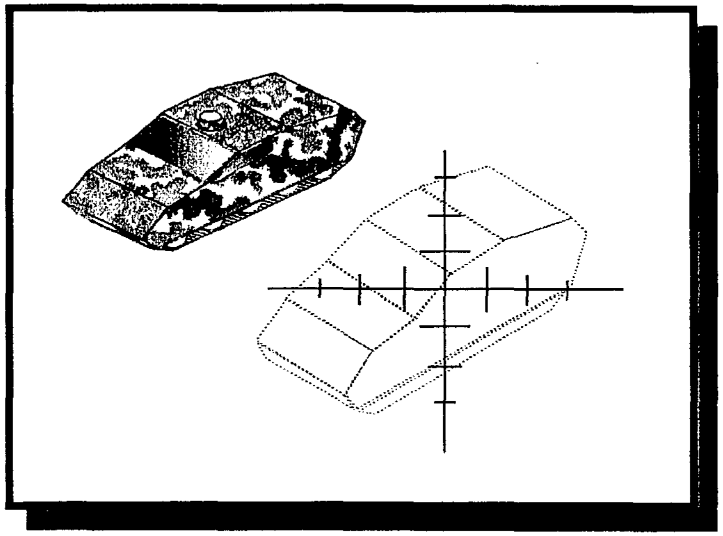
Armor technologies developed under this task have the potential for transition to the AAA program, PE 63611M. Armors developed for existing vehicle programs would transfer to Product Improvement Programs (PIPs) for the individual vehicles, specifically LAVs, and all light and medium tactical vehicle fleets. Hit Avoidance Technologies will transfer to the appropriate PM's.

Relationship to Other Programs

USMC armor development efforts are related to the Army and Air Force through the CLASP. This effort is monitoring industry efforts in material development for armor application. Hit Avoidance Technologies are related to an ongoing US Army Hit Avoidance ATD.

THIS PAGE INTENTIONALLY LEFT BLANK.

INTEGRATED SURVIVABILITY



OBJECTIVE:

- DEMONSTRATE ON VEHICLE INSTALLATIONS THE TECHNOLOGIES FOR VEHICLE SURVIVABILITY, INCLUDING DETECTION, ACQUISITION, HIT, PENETRATION AND KILL AVOIDANCE SYSTEMS.

CAPABILITIES:

- S&T ISSUE BEING ADDRESSED:
  - SIGNATURE REDUCTION (Y-Q1)
  - VEHICLE STRUCTURE SURVIVABLE TO KINETIC/BLAST PENETRATION (R-Q1)
  - ALL TERRAIN/WEATHER/ENVIRONMENT (G-Q1)
- ADDRESS CWL NEED FOR DECEPTION/STEALTH

APPROACH:

- NAPDD EXISTS - CLASSIFIED OBJECTIVES
- TRANSITION/EXECUTION OF JASE PROGRAM FROM 6.2
- EFFORTS CLASSIFIED
- JOINT WITH ARMY
- WILL INCORPORATE ONTO RST-VEHICLE ATD
- POTENTIAL APPLICATION TO URBAN WARRIOR AWE

PERFORMERS:

- NSWC-CARDEROCK, ARMY - NVL, LOCKHEED-MARTIN

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
JASE DEVELOPMENT	CLASSIFIED			
JASE TEST				
RST-V INTEGRATION				

TRANSITION:

- PM - GROUND WEAPONS, PM-AAV, DRPM-AAA, PM-LAV, PM-CSS

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 10. INTEGRATED SURVIVABILITY/SPECIAL PROGRAMS

Problem/Deficiency

Each USMC platform has a unique mission. With the mission comes a threat scenario and survivability needs. The integration of the required technologies for this survivability "suite" requires an integrated approach. The approach of adding specific technologies that are the best in their field produces a survivable platform but also a potentially unfieldable platform due to cost, weight, volume, etc. The approach will be to maximize the overall pay-off of the combined technologies in a survivability "suite" integrated onto the platform such that it is affordable and does not inhibit the ability of the platform to perform its mission.

Technical Objective/Expected Payoffs

The technology objective of this task is to provide a suite that provides for the total survivability needs for the particular platform. The various applicable technologies for the platform will be evaluated via trade-offs to determine the optimal system for a given weight, cost, durability, volume, etc. The payoff will be a survivable platform that is able to perform it's mission role where the technologies of the survivability "suite" are working together and are transparent to the end user.

Technical Background and Approach

This task will utilize existing technologies from Tasks 8 and 9. This task will also potentially develop other technologies via special programs. Technologies developed previously under Advanced Armor Technology, Tactical Deception Technology, Advanced Land Combat System (ALCOS) Generation II (GEN II), Joint Advanced Survivability Experiment (JASE) and False Target Generator may all play a role in this Task. The primary evaluation tool for this Task will be the Threat Oriented Survivability Optimization Model (TOSOM) developed by the Army and used by Program Executive Officer - Armored Systems Modernization (PEO-ASM) and Program Manager - Armored Systems Integration (PM-ASI). This model will be available at the start of FY97. The TOSOM provides a methodology for optimizing the survivability needs of a platform for single encounters with particular threats. The culmination of TOSOM runs with the perceived threats will produce the final requirements for the survivability system.

Summary of Prior and Current Years' Work

The concept of integrated survivability is a new start effort in FY97, however, the technologies that it will incorporate at the start will be relatively mature from previous Tasks. In addition, this task incorporates two ongoing special programs (ALCOS GEN II and JASE) that are scheduled to continue through FY97.

Planned Work

The Integrated Survivability efforts will be new starts in FY97 and will involve using the TOSOM for developing the survivability systems. The primary systems of interest will be the ATDs scheduled for FY98, i.e., RSV and FLCV. A threat assessment for the FLCV was conducted in FY96 and will be the primary building block for developing a system. Similar efforts are anticipated for the RSV and follow-on TOSOM runs are likely.

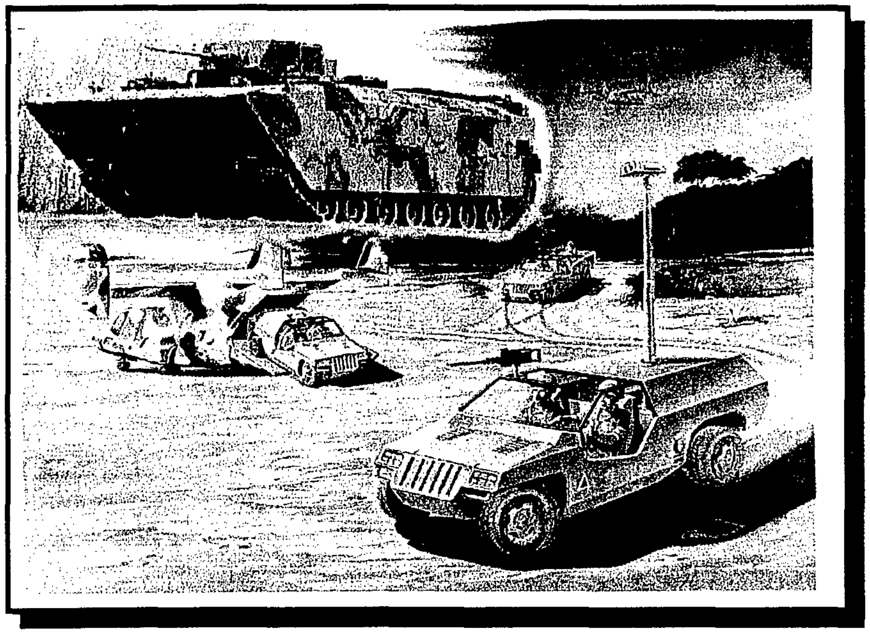
Planned Transitions

The appropriate PMs will incorporate hardware developed under these tasks. This technology is expected to transition in the mid to long-term.

Relationship to Other Programs

This technology has application to the ATD programs.

MAGTF SURVIVABILITY



OBJECTIVE:

- DEVELOP THE TECHNOLOGIES FOR INSERTION TO VEHICLE PLATFORMS COVERING ALL ASPECTS OF SURVIVABILITY. SERVE AS READILY-ACCESSIBLE USMC EXPERT FOR SURVIVABILITY MATTERS

CAPABILITIES:

- S&T ISSUE BEING ADDRESSED:
  - SIGNATURE REDUCTION (Y-Q1)
  - VEHICLE STRUCUTRE SURVIVABLE TO KINETIC/BLAST PENETRATION (R-Q1)
  - ALL TERRAIN/WEATHER/ENVIRONMENT (G-Q1)
- ADDRESS CWL NEED FOR DECEPTION/STEALTH

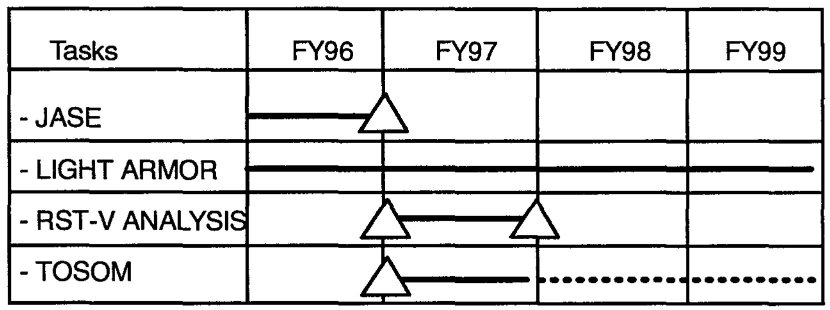
APPROACH:

- JOINT ADVANCED SURVIVABILITY EXPERIMENT (JASE)
- JOINT WITH ARMY AND DARPA - ACTD
- LIGHTWEIGHT ARMOR EVALUATION FOR COMBAT VEHICLES
- RST-VEHICLE SURVIVABILITY ASSESSMENT AND SYSTEM DEVELOPMENT FOR JOINT DARPA-USMC ATD
- MODELING AND SIMULATION OF USMC GCE VEHICLES USING THREAT ORIENTED SURVIVABILITY OPTIMIZATION MODEL (TOSOM) TO ADDRESS FUTURE CAPABILITIES
- LOW OBSERVABLE TREATMENT EMBEDDED WITH ARMOR TILES - JOINT USMC-ARMY-NAVY

PERFORMERS:

- NSWC-CARDEROCK
- BOOZE-ALLEN HAMILTON, TELEDYNE BROWN

SCHEDULE:

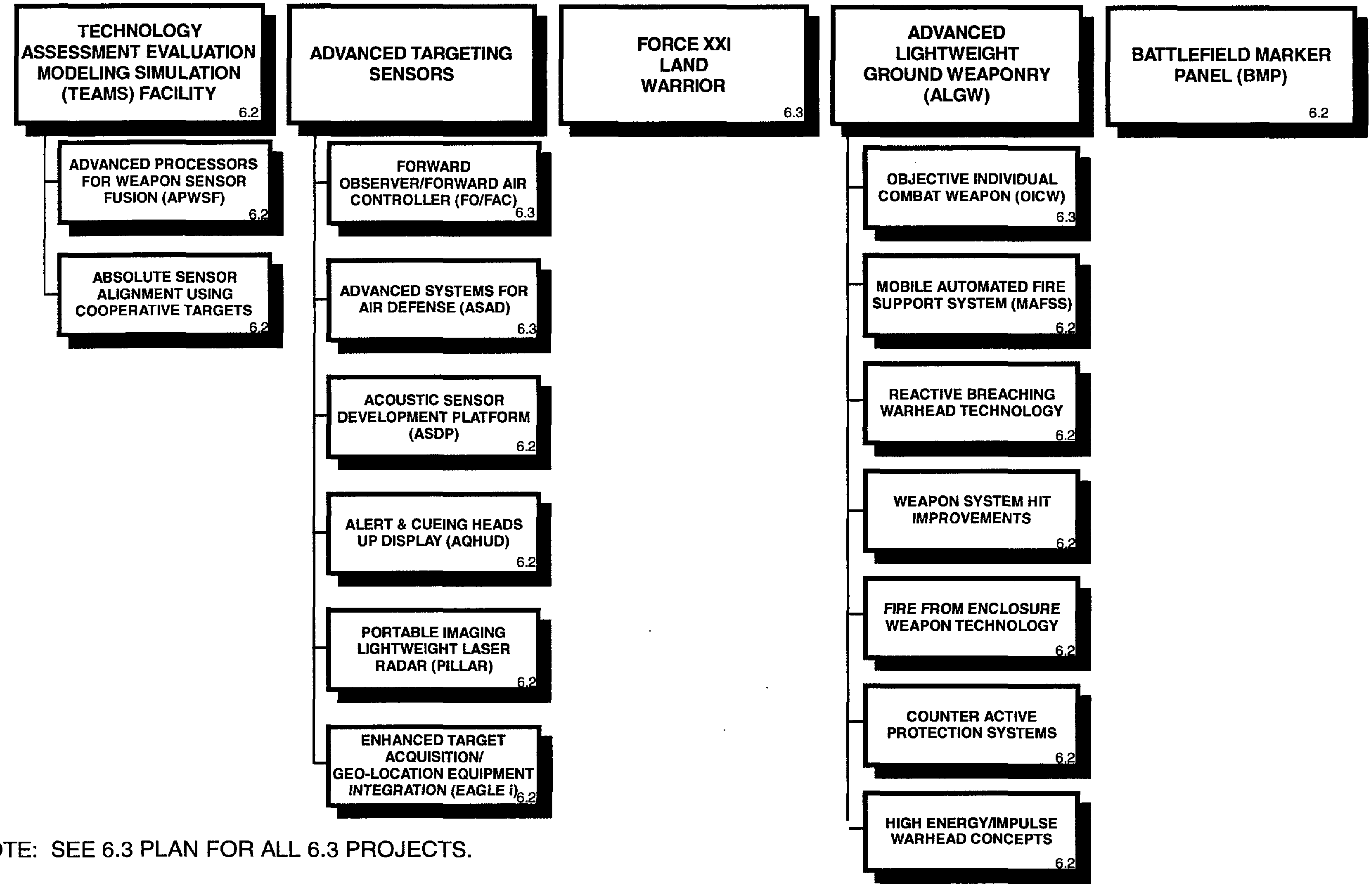


TRANSITION:

- PM - GROUND WEAPONS, PM-AAV, DRPM-AAA, PM-LAV, PM-SSC, INTEGRATED SURVIVABILITY ATD

THIS PAGE INTENTIONALLY LEFT BLANK.

FIREPOWER IMPERATIVE



NOTE: SEE 6.3 PLAN FOR ALL 6.3 PROJECTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

Imperative Title: FIREPOWER

THIS PAGE INTENTIONALLY LEFT BLANK.

FIREPOWER IMPERATIVE

PRINCIPAL OBJECTIVE AND TECHNICAL THRUSTS

The primary purpose of the Firepower Imperative project is to develop, integrate, and demonstrate innovative technologies for weapons and targeting sensors and to demonstrate the technologies and concepts to provide enhanced warfighting capabilities through new or improved Marine Corps weapons and/or weapon systems. Future weapons will have significantly greater range and lethality. Therefore, the capability requirements for targeting sensors must extend beyond the ranges of the associated systems. The increased lethality, coupled with a significantly more dynamic and fluid battlefield, make greater situation awareness and positive target recognition and identification imperative. Innovative algorithms and advanced processors for specific targeting sensors and disparate weapon system sensors are fundamental to achieving the project objectives. Firepower Imperative goals are:

a. Achieve the capability to penetrate obscurants across the spectrum to successfully engage defilade/concealed targets.

b. Increase weapon systems effectiveness and lethality while decreasing weight, cost, and logistical requirements.

STRUCTURE AND TASK IDENTIFICATION INCLUDING OUTYEAR NEW STARTS

The tasks for the Firepower Imperative, and their accompanying objectives are listed in the following paragraphs.

TEAMS Facility

Investigate advanced processing methods and hardware to enhance developing weapon sensor systems and test and evaluate emerging tactical sensor technologies through integration of components, systems, test facilities, and maneuver warfare sites.

Advanced Targeting Sensors

Develop, integrate, and demonstrate the technologies required to achieve comprehensive and adaptable solutions for determining and communicating the geo-coordinates of tactical targets and providing near real time situation awareness for the maneuver elements.

ALGW

Develop technology to make emerging weapons and weapon systems more effective, lighter, easier to use, more survivable, and more mobile.

BMP

Develop technology to improve the capability to designate targets for close air support (CAS) and mark terrain for control/coordination.

FIREPOWER IMPERATIVE FUNDING ($K)

TASK NO	PERFORMER	FY96 CURRENT FY	FY97 EXECUTION FY	FY98 BUDGET FY	FY99 BY+1 FY	FY00 BY+2 FY
1	NSWCDD	0	1050	800	1200	1200
	BAA/CONTRACTOR	0	1000	700	1100	800
2	NSWCDD	1466	550	700	600	600
	NAWC/CL	150	150	0	0	0
	CONTRACTOR	770	450	200	200	200
3	NSWCDD	480	836	800	600	800
	BAA/CONTRACTOR	84	150	400	200	200
4	ARDEC	50	0	0	0	0
	CONTRACTOR	0	0	0	0	0
	PROJECT TOTALS	3,000	4,186	3,600	3,900	3,800

TASK NO.	TITLE
1	TECHNOLOGY EVALUATION ASSESSMENT MODELING SIMULATION FACILITY
2	ADVANCED TARGETING SENSORS
3	ADVANCED LIGHTWEIGHT GROUND WEAPONRY
4	BATTLEFIELD MARKER PANEL

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. TECHNOLOGY EVALUATION ASSESSMENT MODELING SIMULATION (TEAMS) FACILITY														
A. ADVANCED PROCESSORS FOR WEAPON SENSOR FUSION														
(1) Determine Feasibility														
(a) Subsystem Test				C										
(2) Prototype System			C											
(a) Hardware Fabrication			C	D										
(b) Integration	S		C											
(3) System Demonstration		S	C	R										
(a) Field Testing		S	C											
(b) Analysis	S		C											
(c) Transition				T										

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. TECHNOLOGY EVALUATION ASSESSMENT MODELING SIMULATION (TEAMS) FACILITY														
B. ABSOLUTE SENSOR ALIGNMENT USING FOR COOPERATIVE TARGETS														
(1) Develop alignment algorithms	S			C										
(2) Develop alignment module and GPS/Comm unit	S			C										
(3) Develop sensor integration algorithms for CACC and Tennessee	S			C										
(4) Test algorithms in simulated environment				S		C								
(5) Write report describing alignment algorithms						S	C							
(6) Live demonstration of alignment algorithms and hardware						S	C							
(7) Tactical Sensor System Demonstrations & Assessments														
(a) Identical Sensor Demonstration					S		C	R						
(b) Sensor Demonstration						S	C	R						
(c) Disparate Sensor									S			CR		
(d) Multisensor Demonstration										S			C R	
(e) Environmental Sensor Demonstration												S		C R
(8) Write report on demonstration							S	C						
(9) Supporting Technologies														
(a) Technology Transfer/Coordination			R	R										
(b) Broad Agency Announcement														
- Selection Process		R		R			R	R			R		R	R
- Contract Awards	S	R		R			R	R			R		R	R
(c) Identify Enhancement Opportunities		S		C		S		C						
(d) Develop/Start CCS Systems	R			R			R				R		R	R
(e) Implement CCS Systems/Test Bed Concepts		R/D		R										
(f) Request for Information			S	CRS				CRS				CRS	CRS	C
(g) Develop Implementation/Support Plan for TEAMS Facility				S C	R									

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. ADVANCED TARGETING SENSORS														
A. ACOUSTIC SENSOR DEVELOPMENT PLATFORM														
(1) Investigate the different types of acoustic processing		S	C											
(2) Purchase elements of development platform daughter boards		S	C---------	C										
(3) Write and test software			S---S	C---C										
(4) Integrate different types of signal processing			S	C---	-------	C								
(5) Evaluate performance of the system					S	C								
(6) Write technical report					S	C								

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. ADVANCED TARGETING SENSORS														
B. ALERT & CUEING HEADS UP DISPLAY (AQHUD)														
(1) Concept Definition	$\underline{S}$	$\underline{C}$ ----	----	----	C									
(2) Technology Assessment														
(a) RFI	$\underline{S}$	$\underline{C}$												
(b) Evaluate/Procure Prototype(s)		$\underline{S}$		$\underline{H}$										
(3) System Integration/Demo														
(a) Hardware/Software Development				$\underline{S}$	C									
(b) Avenger/MANPADS Integration				$\underline{S}$		C								
(c) DEMO						D								
(4) AQHUD Development/Procurement														
(a) System Specification					S		C							
(b) BAA/RFP & Contract Award						S		C		H				
(c) DEMO											D			
(d) Transition												T		

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. ADVANCED TARGETING SENSORS														
C. PORTABLE IMAGING LIGHTWEIGHT LASER RADAR (PILLAR)														
(1) Contract for Laser Transmitter					S		C							
(2) Deliver Laser Transmitter										C				
(3) Contract for Laser Receiver					S			C						
(4) Deliver Laser Receiver									C					
(5) Display Software Development									S	C				
(6) Contract Scanner Optics					S	C								
(7) Deliver Scanner Optics						C								
(8) Purchase Scanner Hardware					S		C							
(9) Build and Test Scanner						S		C						
(10) Purchase Optics Hardware									S	C				
(11) Sensor Integration										S		C		
(12) Field Demonstration													S C	
(13) Final Report/ATD Plan													S C	

MILESTONE SYMBOL LEGEND

S = Start	---- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. ADVANCED TARGETING SENSORS														
D. ENHANCED TARGET ACQUISITION/GEO-LOCATION EQUIPMENT INTEGRATION														
(1) Optical Subsystem Stabilization														
(a) Define Design Requirements (Completed FY95)														
(b) Software Development (Completed FY95)														
(c) Preliminary Hardware Design (Completed FY95)														
(d) Detailed Design/Fabrication	--<u>C</u>													
(e) Breadboard Test, Evaluation & Demonstration	<u>D</u>													
(f) Report	--<u>R</u>													
(2) High Accuracy Azimuth Effort			<u>S</u>			<u>C</u>	<u>R</u>							
(3) User Interface Development	<u>S</u>			<u>C</u>										
(4) Thermal Imaging/TV/Direct View Optics Integration					S			C						
(5) System Integration and Demonstration									S			C		
(6) Final Report													R	

MILESTONE SYMBOL LEGEND

S = Start	--- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
A. MOBILE AUTOMATED FIRE SUPPORT SYSTEM (MAFSS)														
(1) Mortar/Autoloader Interface Component (Completed FY95)														
(2) Autoloader Design, Fabrication, and Test														
(a) Chambering (Completed FY95)														
(b) Extraction and Ejection (Completed FY95)														
(c) Ramming, Feeding, and Transfer				C										
(d) Vertical and Horizontal Transfer			C											
(3) Feasibility Demonstration	S			C										
(4) Technology Roadmap					D									
(5) Report							R							
(6) Transition							T(PE63XXX)							

MILESTONE SYMBOL LEGEND

S = Start	---- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
B. REACTIVE BREACHING WARHEAD TECHNOLOGY														
(1) Reactive Materials Analysis	S̲										C			
(a) *Identification*	S̲				C		R							
(b) Penetration Parameters		S̲					C							
(c) Concrete Reaction Parameters		S̲						C						
(d) Damage Mechanisms		S̲						C						
(e) Explosive Launching Techniques			S̲				C							
(f) Interactive Damage Mechanism						S					C			
(g) Encapsulants			S̲								C			
(2) Scale Testing				S̲								C		
(a) Launching Techniques							S					C		
(b) Penetration				S̲								C		
(c) Reaction Mechanisms				S̲							C			
(3) Warhead Concept Design Iterations							S						C	
(a) Warhead Static Demonstrations											S		D	
(b) Warhead Dynamic Demonstrations													S D	

MILESTONE SYMBOL LEGEND

S = Start	---- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
C. WEAPON SYSTEM HIT IMPROVEMENTS														
(1) Review/Identify Technologies					S			C R						
(2) Conceptual Subsystem Design							S					C		
(3) Investigate Critical Parameters								S					C R	
(4) Conduct Component Testing										S			C	R
(5) System Integration Demon Hardware Fabrication													S C	
(6) Proof of Principle Demonstration														S C R
(7) Final Technical Report														R

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS) 1	2	3	4	FY97 EXECUTION YEAR (QUARTERS) 1	2	3	4	FY98 BUDGET YEAR (QUARTERS) 1	2	3	4	FY99 (BY+1)	FY00 (BY+2)
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
D. FIRE FROM ENCLOSURE WEAPON TECHNOLOGY														
(1) Review/Identify Technologies					S			C	R					
(2) Performance Analysis/Trade-off						S						C R		
(3) Investigate Critical Parameters									S				C R	
(a) Select Hardware									S	C R				
(b) Conduct Component Testing									S				C R	
(4) Hardware Fabrication													S C	
(5) Hardware Demonstration													S C	
(6) Final Technical Report														R

MILESTONE SYMBOL LEGEND

S = Start	--- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
E. COUNTER ACTIVE PROTECTION SYSTEMS														
(1) Identify Technologies					S			C	R					
(2) Trade Studies and Analysis						S			C R					
(3) Critical Subsystem Development							S				C			
(4) Critical Subsystem Hardware Fabrication										S			C	
(5) Demonstration													C	
(6) Final Technical Report													R	

MILESTONE SYMBOL LEGEND	
S = Start	--- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
F. HIGH ENERGY/IMPULSE WARHEAD CONCEPTS														
(1) Identification of Concepts					S			C	R					
(2) Analysis of Concepts						S				C R				
(3) Warhead Design							S				C R			
(4) Warhead Fabrication									S			C	R	
(5) Static Warhead Testing										S		C	R	
(6) Analysis of Test Results												S	C R	
(7) Improve Warhead Design													S C	R
(8) Static Warhead Testing													S	C R
(9) Dynamic Testing														S
(10) Final Technical Report														C

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)														
G. SUPPORTING TECHNOLOGY														
(1) Request Solutions for Needs				C	S							C		
(2) Evaluate Proposed Solutions (Completed FY95)														
(3) Initial Efforts	----CR													
(4) Follow-on Efforts														
Lightweight 81mm Mortar	S----	----	----	----	----C									
(a) Phase I		CR												
(b) Phase II		S			CR									
(c) Phase II & Testing					S			CDRT-1						
(5) BAA													S	CR
(6) BAA														S C

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Technology available for use in follow-on efforts as appropriate

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: FIREPOWER (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 4. BATTLEFIELD MARKER PANEL														
A. Material Development		H												
B. Technical Evaluation	R	D------	------	------D	R									
C. Operational Testing		D												
D. Working Prototype				H										
E. Engineering Change/Transition					ST									
F. Final Report					R									
G. Point Recognition Projectile Final Report			R------	------	R									

MILESTONE SYMBOL LEGEND	
S = Start	---- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 1. TECHNOLOGY EVALUATION ASSESSMENT MODELING SIMULATION FACILITY

Problem/Deficiency

Advanced Processors for Weapon Sensor Fusion (APWSF). Future weapon systems will not be characterized by fire power only but, by necessity, will require an increasing degree of cognitive function. The required future effectiveness necessitates a focused effort in sensor fusion and processing technology in order to provide the Marine Corps with the needed weapons and associated sensor systems.

Absolute Sensor Alignment Using Cooperative Targets. One of the most critical needs of the Marine Corps commander is having a timely, consistent, and accurate tactical picture which is obtained by fusing information from all available sources. However, in order to meaningfully fuse this information, all of the sensors supplying data must be accurately aligned. At this time, there are few techniques available for aligning a suite of land-based sensors where some are found on mobile platforms.

Technical Objective/Expected Payoffs

APWSF. The objective of APWSF is to investigate and develop advanced sensor data processing technologies in order to provide future USMC weapon systems with the capabilities of automatic target detection, accurate target classification, and, where appropriate, autonomous operation. The technology development occurring within the APWSF task has broad application to surveillance, scouting, intelligence gathering, weapons targeting, weapons control, information processing and sharing, and tactical planning in a variety of military systems. Most importantly, this effort will provide superior capability to previous systems and methods especially in degraded and non-optimal conditions where previous technologies, in many cases, provide no solution. Specific payoffs expected are:

(1) Improved system capabilities;

(2) Automated system operation;

(3) Increased processing speed/performance;

(4) Reduced system size;

(5) Fusion of disparate sensors;

(6) Cognitive processes - advances in machine intelligence; and,

(7) Development of an acoustic sensor development platform (ASDP).

Absolute Sensor Alignment Using Cooperative Targets. The objective of this sub-task is two-fold. The first objective is to develop algorithms that will determine sensor bias errors that can be used to absolutely align each of the sensors found in a USMC battalion with the aid of cooperative targets and to test these algorithms in simulation. The second objective is to assemble equipment that is sufficient to perform the alignment of a single sensor on a platform (whose orientation can be adjusted) using a single cooperative target and use it to demonstrate the sensor alignment algorithms.

The alignment of Marine Corps organic sensors will allow the accurate fusion of data from these disparate sensors. Some of the desired effects resulting from this synergism between multiple sensors are:

1. The integration of these sensors can improve IFF;

2. The existence of the interconnection between the sensors will provide weapon systems the ability to address targets out of the stand-alone FOV and/or range of their sensor(s);

3. The redundancy afforded by the overlapping FOV that result from fusing data from multiple sensors diminishes or negates the effects caused by losing one or several sensors;

4. The alignment of the sensors provides a higher probability of correlation of single target data from multiple sensors thereby increasing the probability of correctly identifying the target; and,

5. When the sensors are properly aligned, it is possible to achieve a more accurate fire control solution by fusing kinematic data from multiple sensors.

Technical Background and Approach

APWSF. APWSF is actively pursuing emerging computer technologies stemming from recent advances in Simulated Biological Intelligence (SBI) which can endow machines with human-like capabilities to process large amounts of data and form generalizations, thus allowing them to deal with constantly varying and incomplete information. SBI includes biologically inspired processes such as cochlear (inner ear) and retinal (eyes; optic nerve and visual cortex) models for acoustic and image data processing. Previous research at NSWCDD and other laboratories has concluded that emerging technologies such as artificial neural systems (ANS), fractal geometry, wavelet analysis, etc., utilized in conjunction with state-of-the-art digital and analog processes, can provide real-time processing of target data. This offers a host of new applications and system improvements and, in some cases, provides solutions to problems previously intractable with conventional methods.

In addition, since no single algorithm is likely to produce an adequate ATR solution for the majority of applications, ATR systems must be comprised of multiple processes. Some of the processes will be sequential, e.g. data acquisition must occur before processing, while others are best approached concurrently. An architecture comprised of a processor responsible for resource allocation, resource monitoring, and user interface can direct an arbitrary number of heterogeneous special purpose processors. A separate input path will provide simultaneous access to various sensor data. The following approach will be pursued.

1. Develop hardware requirements for beam steering, four fourier transforms (FFT), wavelet, and other types of acoustic processing.

2. Investigate the capability of signal processing hardware such as FFT and wavelet Integrated Circuit (IC) chips.

3. Build a platform utilizing different methods of signal processing.

4. Integrate different types of signal processing algorithms to see how the system performs.

<u>Absolute Sensor Alignment Using Cooperative Targets</u>. The alignment problem occurs whenever there is a combining and/or sharing of information between several sensors and/or weapon systems. Alignment is the process of representing the data from several sensors in a common coordinate system without incurring any errors. Alignment errors can be caused by errors in the locations of the sensors and weapon systems (i.e., not knowing their precise locations), bias or offset errors in the sensors and weapon systems, orientation errors in the reference frames associated with the sensors and weapon systems, timing errors in their clocks, etc. The presence of uncorrected alignment errors in a multi-sensor surveillance and/or fire control system can result in two possibilities. First, the magnitude of the uncorrected alignment errors may be so large that it is impossible to associate tracks of a given target held by two or more sensors in their shared coverage zones. Second, even when the position data from different sensors does correlate, it is possible that the errors may be of such magnitude that the fused tracks will be less accurate than the tracks that would be generated using measurements from each sensor separately.

Any alignment procedure is basically an aligning of the sensors and/or weapon systems to a "standard." In practice, the standard must be "observable" by all the elements that are to be aligned. There are two basic alignment concepts used in practice: (1) relative alignment and (2) absolute alignment. In relative alignment, one sensor is chosen as the "master" or "primary" sensor which is assumed to be perfectly aligned (i.e., free of alignment errors). Then, all of the other sensors in the integrated system are aligned relative to the master sensor. The shortcomings of the relative alignment method is that the master sensor may have alignment errors so that relative alignment produces an alignment that is no better than the alignment accuracy of the master sensor. This can create problems if data from sources outside the integrated system is brought into the integrated system where the remote sensor reporting this data is not observable to the master sensor.

Absolute alignment refers to the process of aligning all of the elements in an integrated system to an absolute or "true" standard. It usually refers to the process of determining the alignment errors in each individual sensor in the integrated system. Note that relative alignment does not determine the alignment errors in each individual element; rather, it only determines alignment errors relative to the master sensor. Of course, relative alignment will produce absolute alignment if the master sensor is aligned to a true standard. Absolute alignment in integrated systems has not been popular because of the lack of "true" standards that are "observable" by the elements in an integrated system. However, with the advent of the Global Positioning System (GPS) and Inertial Measurement Units (IMUs), standards that closely approximate truth are now available or will be in the near future.

Summary of Prior and Current Years' Work

APWSF. Rotary wing aircraft acoustic feature extraction, based on enhanced harmogram methods, has been demonstrated using acoustic data obtained from the US Army's Picatinny Arsenal. Modifications to enhance the capabilities of this method have been documented in both internal and external publications by APWSF researchers. This technology has been transitioned to the Advanced Systems for Air Defense (ASAD) program and has been implemented in an acoustic detection and classification component of the system. The report, *Enhanced Harmogram Analysis Techniques for Extraction of Principal Frequency Components*, was presented at and published in the proceedings of the International Conference on Signal Processing and Technology.

Sample ground combat vehicle acoustic data was obtained from the US Army's Waterway Experiment Station (WES). This data was used to support FY94 efforts.

Wavelet transforms have been investigated for the detection of rotary wing aircraft acoustic signals and have performed well compared to traditional mathematical techniques. The results of this investigation have been published in a technical report (NSWCDD/TR-93/169).

An ANS has been demonstrated to be capable of very accurate classification of helicopters. Tested on real field data provided by the US Army, the ANS has shown near instantaneous performance with near 100-percent accuracy. A report entitled *Artificial Neural System Development for Airborne Acoustic Signature Classification* was presented at and published in the proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE) International Symposium on Intelligent Information Systems, Conference 1955: Signal Processing, Sensor Fusion, and Target Recognition.

The Concurrent Paradigm based Automatic Target Recognition (CPATR) platform provides a flexible test bed for implementing simultaneous sensor processing functions and allows hardware development in support of specific signal processing and target recognition paradigms. The CPATR platform is capable of integrating and fusing disparate sensors, e.g., acoustic and IR, in a portable package. Thus allows testing of advanced processor implementations in the actual environments.

Absolute Sensor Alignment Using Cooperative Targets. Equipment development began in FY96.

Planned Work

APWSF. Further design concepts will be generated, modeled, and evaluated. Models will be tested on real sensor data whenever possible. Whereas the previous effort has focused primarily on detection and classification of airborne targets, future efforts will be directed toward applying APWSF techniques to enable detection and classification of ground combat vehicles as well.

Increased emphasis will be placed on hardware implementation of processing paradigms and development of the CPATR platform. Fourier, wavelet, and harmogram preprocessing techniques will be considered for implementation on the CPATR architecture providing features for an ANS classifier.

Investigations of wavelet analysis under APWSF has indicated that a wavelet approach may provide the means to definitively identify rotary-wing aircraft based on unique, transient-like characteristics associated with the aircraft's physics. Identifying a characteristic wavelet and generating a wavelet based feature set will be investigated.

Absolute Sensor Alignment Using Cooperative Targets. The use of several techniques for time-aligning the three measurements will be investigated in FY96 and FY97. The development and testing for selection of the "best" technique began in March 1996 and will end in December 1996.

In order to actually accomplish the "absolute" alignment of the sensors found in a Marine Corps maneuver element in real-time or near real-time (the fixed lag smoothing technique is not quite real-time) it will be necessary to locate a GPS unit and a capability for determining sensor orientation (e.g. IMU) on each platform having at least one sensor. These platforms will also require hardware for extracting measurements from the sensor(s) on that platform, a computer for computing the sensor alignment and accounting for the asynchronicity of the data, and a communications node that is linked to a central processor, all the cooperative targets, and all sensors. Additionally, it will be necessary to have a GPS unit on one or more cooperative targets. Some time will be spent in the latter part of FY97 to determine what contractors are doing this type of work. This will help in the preparation of a Request For Proposals (RFP) that will lead to the production of GPS-IMU-Computer-Communication (for each sensor platform) and GPS-Communication (for placement on targets) modules for the TD that is planned to start in FY98.

For the purposes of this task, the ability to align a single sensor using a single target will be demonstrated. Equipment development that began in FY96 will be completed in May 1997.

Transition Plan

APWSF. The successes of APWSF have broad application to the next generation of weapons and sensor systems. The technology developed in FY92 through FY95 is being used for target detection and classification for the ASAD programs. This FY, the EARS program benefited from signal processing and target classification technologies developed in APWSF and will borrow heavily from the lessons learned on the CPATR platform.

Absolute Sensor Alignment Using Cooperative Targets. This work will be transitioned to the Intelligent Fire Control Sensors (IFCS) TD that will start in FY98 within the Marine Corps Targeting Sensors Technology Program. This TD will be funded jointly by the USMC and the Expeditionary Warfare Directorate Office of the Chief of Naval Operations (OPNAV 85).

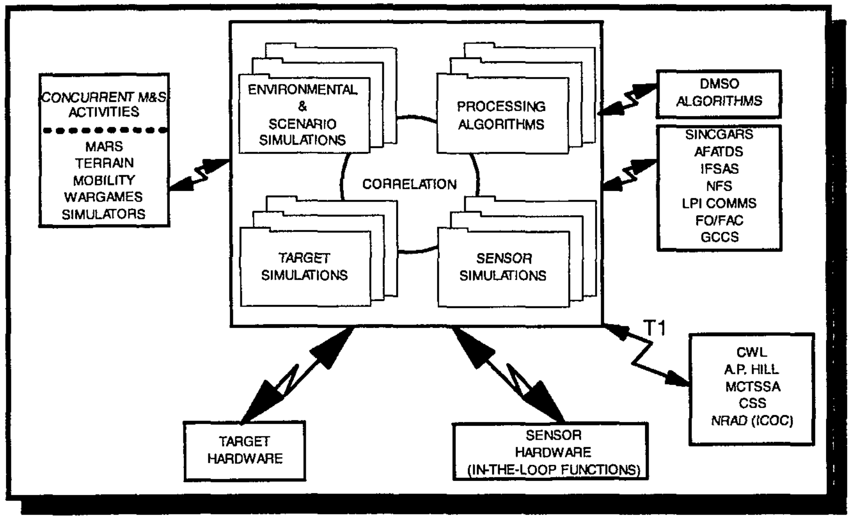
Relationship to Other Programs

APWSF. In recent years, NSWCDD has been gaining valuable experience in the application and hardware implementation of advanced signal processing and target detection algorithms including, but not limited to, neural networks and non-parametric statistical classifiers.

Technologies developed under APWSF complement the efforts of the Naval Air Warfare Center Weapons Division's neural network programs and the signal processing and target identification work of US Army Laboratories in conjunction with the Force XXI Land Warrior (FXXI LW) concept.

Absolute Sensor Alignment Using Cooperative Targets. Johns Hopkins University/Applied Physics Laboratory (JHU/APL) has been the Technical Direction Agent for the SGS. Research and development is still on-going in this area. JHU/APL is also one of the major developers for the Advanced Self Defense System for PEO Theater Air Defense (TAD). It is developing automatic and adaptive alignment algorithms for use on their next generation prototype system.

TECHNOLOGY EVALUATION, ASSESSMENT, MODELING, SIMULATION (TEAMS) FACILITY



OBJECTIVE:

- DEVELOP THE FACILITIES FOR REAL-TIME EVALUATION OF EMERGING AND INNOVATIVE TECHNOLOGIES FOR WEAPONS/SENSOR INTEGRATION AND REAL TIME TACTICAL TARGETING AND SITUATIONAL AWARENESS UTILIZING USMC COMMUNICATIONS ARCHITECTURE

CAPABILITY:

- TEST AND EVALUATION: VIRTUAL PROTOTYPING (Y-Q2)
- MULTIPLE SENSOR TARGET PROCESSING (G-Q1)
- FUSION OF BATTLEFIELD SENSORS AND ABILITY TO PUT FIRST ROUND ON TARGET (G-Q2)

APPROACH:

- ESTABLISH T1 COMMUNICATIONS
- SENSOR HARDWARE IN-THE-LOOP TEST AND EVALUATION
- INTEROPERATE WITH VIRTUAL M&S FACILITIES
- INTEGRATE WITH EXISTING AND EMERGING USMC C2
- INTEGRATE WITH/SUPPORT CWL AWEs/LOEs

PERFORMERS:

- NSWCDD, NRAD, NAWC, A.P. HILL, ARMY LABS,
- OPTIMETRICS, PENN STATE

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
ESTABLISH INITIAL TEAMS FACILITY CAPABILITY	▲ ▲			
FO/FAC - NFS LIVE FIRE	▲	△		
BASIS MODEL INTEGRATION		△ △		
SMOKE AND OBSCURANT MODEL INTEGRATION		△	△	
SENSOR-AFATDS INTEGRATION	▲		△	
T-1 SITE CONNECTIONS & EVALUATION		△	△	
MULTIPLE SENSOR ALIGNMENT DEMOS		△		△

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 2. ADVANCED TARGETING SENSORS

Problem/Deficiency

The most significant constraint on the performance of future weapon systems of a maneuver unit is the performance of the targeting sensors that provide acquisition, identification (ID), and effective engagement. Faster and more lethal weapon systems require supporting fire control systems to rapidly acquire, track, recognize, identify, and engage targets. Battlefield environmental challenges such as significantly increased engagement ranges, high operation tempo, obscuration, and terrain masking must be effectively overcome. Disparate sensors operating in different mediums require sophisticated integration in order to properly support the weapon system. The functional area of targeting sensors is an increasingly dynamic growth area. A technology roadmap is required by the Marine Corps to ensure a quality effort within the Targeting Sensor Project. The tactical, operational, and engineering parameters of the sensors that support fire control need to be defined. The need for an improved targeting capability weapon system and maneuver unit performance is articulated in: Mission Area Analysis (MAA) 21-Direct Fire and Maneuver; MAA 12-Intelligence; and, MAA 24-Fire Support.

ASDP. The development of tactical targeting and surveillance systems requires a convenient portable platform supporting rapid prototyping and the evaluation of acoustic sensor processes for accurate feasibility and return-on-investment analysis.

Alert and Cueing Heads Up Display (AQHUD). Stinger missile gunners (Avenger, Man Portable Air Defense System (MANPADS)) currently view the tactical air picture on conventional displays which provide target alert and cuing, classification, and ID information. Once a target has been selected for engagement, the gunner must slew to the appropriate Azimuth (AZ) and Elevation (EL) and visually acquire the target. In order to maintain situation awareness (e.g. target position, ID, priority) the gunner must continue to monitor the display and search for the target simultaneously. This can cause inefficiencies in the gunner's ability to acquire and engage the highest priority threat. An additional deficiency of the MANPADS gunner is the inability to accurately align the weapon to received target cuing data.

Portable Imaging Lightweight Laser Radar (PILLAR). The engineering and reconnaissance soldier as well as the Forward Observer (FO) and the Forward Air Controller (FAC) of the future must provide exceptionally accurate targeting and battle damage information. The "Tactical Intelligence Photo Capability" mission need statement (MNS) has identified a requirement to provide the soldier a hand held imaging capability to perform these functions. Another MNS, the "Analytic Photogrametric Positioning System" is required to provide precision elevation information of the battlefield.. The PILLAR sensor can meet both of these requirements.

Enhanced Target Acquisition/Geo-Location Equipment Integration (EAGLE I). The ability to provide accurate and timely target location information to fire support coordination elements is absolutely essential for effective fire support from naval fire support, field artillery,

mortars, CAS, etc. This targeting information is often obtained from a variety of sources having limited "payload" carrying capability, e.g., FOs and FACs. The equipment currently being used to carry out these missions presents a number of problems. For example, the equipment:

1. Does not provide the accurate and timely targeting data required to exploit the precision of modern fire support weaponry;

2. Is often heavy, awkward, and time consuming to set up and operate;

3. Is ill suited for operating at night or in the presence of obscurants; and,

4. Offers little or no protection for the operator against tactical laser threats.

Technical Objective/Expected Payoffs

The principal objective is to develop an Integrated and Fused Weapon Sensor and Fire Support Coordination System and to develop and/or support the development of Advanced Fire Control (AFC) and Tactical Sensor Technologies.

This effort is motivated by the fundamental importance of Close Combat Surveillance (CCS). Enhanced CCS capabilities pay off directly in increased USMC warfighting capability by enabling high speed and accurate target engagement. The development of a comprehensive strategy for addressing CCS technology development issues will ensure that developmental resources are applied to the CCS areas which will provide the greatest results, avoid duplication, and leverage the engineering effort.

ASDP. The objective is to provide a common platform for the development, test, and evaluation of tactical sensors and signal processing algorithms.

AQHUD. The objective is to provide the gunner with a small, lightweight, "see-through" helmet mounted display (HMD) that will present the tactical air picture yet allow the gunner to visually search for targets. The ability to track the MANPADS gunner's head position will also be incorporated.

The need to alternate between monitoring the conventional display and searching for targets will be eliminated. For MANPADS, head tracking position will allow rapid weapon alignment to received target cues. The HMD capability will improve situation awareness, decrease reaction time, and increase survivability. As the battlefield of the future evolves, there will be an endless variety of additional information that can be provided via HMDs to enhance warfighting capabilities.

PILLAR. The objective is to develop and demonstrate a camcorder sized imaging laser radar. This device will provide the Marine Corps with the most advanced reconnaissance/imaging technology available.

EAGLE I. The objective of this task is develop, integrate, and demonstrate the technologies required to achieve comprehensive and adaptable solutions for determining and communicating the geo-coordinates of ground targets. A principal goal of this effort is to develop and integrate all the functionalities needed to provide and demonstrate an integrated targeting system (laser rangefinder, magnified optics, thermal imager, computer processing, video display, user interface, and data communications) into a small package approximately the size of 7 x 50 binoculars.

The EAGLE I architectural design will be highly modular to allow Remote Target Location Systems (RTLS) technologies to be tailored to meet a number of man-portable (e.g., FOs, FACs, reconnaissance, etc.) and vehicle-borne (e.g., High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)-based systems and UAVs) missions. Modular design will also enable future technology insertion and equipment upgrades to be accomplished in a timely and cost effective manner thereby extending service life and reducing life cycle costs.

Additional benefits RTLS technologies will provide include:

1. More accurate and timely targeting data;
2. Enhanced capability for detecting/identifying targets;
3. Improved situation awareness and reduced risk of fratricide;
4. Enhanced user interface;
5. Increased operator eye protection against tactical laser threats; and,
6. Reduced combat load for foot mobile operators.

Technical Background and Approach

The primary thrust of this task is the identification, focus, and initial development of technologies applicable to CCS. The scope and span of the contributing technologies is very broad and dynamic. The significant challenge is to identify and develop that optimum set of technologies that offers the greatest leverage for Targeting Sensors. A salient factor in this task is the synergistic capitalization upon contributing technologies currently under development in this project and elsewhere. Initial programmatic work to develop Close Combat Surveillance Sensor Technology (CCSST) architecture and approach was conducted in FY92.

ASDP. The main problem with sensor development, test, evaluation, and integration is the lack of a suitable common baseline hardware system. This task will develop a common platform for evaluating different types of acoustic, signaling, and processing and incorporate this platform into the USMC TEAMS Facility.

AQHUD. The main problem with helmet displays in the past has been their size and weight. Developments in cathode ray tube (CRT) and flat panel display technology are making the HMD more practical for military applications. Miniature CRT based HMDs have been around for years. CRT technology has solved some problems, continues to advance, and may provide the best short term solution. Flat panel based HMDs using state-of-the-art liquid crystal display (LCD) technology are rapidly advancing and solving many of the problems associated with CRT based HMDs. For the last 3 years, the ARPA has spent $30 million to advance HMD technology. A variety of options are available with HMDs including sophisticated head tracking systems for sensing head position.

The approach taken here will be to assess available HMD technology and evaluate 1-2 existing HMDs that could produce a near term capability for Avenger and MANPADS gunners. The evaluation will include a "best fit" integration with Avenger and MANPADS to demonstrate the HMD capability. For MANPADS, this will include incorporation of a head tracking system and display indicator that will allow the gunner to align his weapon with the received target azimuth cue. Based on the demonstration results and HMD feasibility for these applications, a system specification will be developed and contract awarded to procure a prototype HMD that meets Avenger and MANPADS operational requirements.

PILLAR. Imaging laser radar technology has been under development for more than 15 years. Most systems built were developed for vehicles capable of carrying hundreds of pounds of sensor and processing equipment.

This program will utilize state-of-the-art laser microchip technology, originally demonstrated by Lincoln Labs, to build a small, lightweight device. This program will extend work currently underway via a SBIR grant from the Air Force. The Air Force program is addressing airborne applications and is going to produce hardware too heavy for individual soldier applications.

The approach involves integrating a linear array of lasers into a single axis scanning optical system to produce an angle-angle-range and intensity (four dimensional) image of a target area. The sensor will generate multiple images per second, dependent upon the total FOV desired.

EAGLE I. The work performed under this task will be organized into several work units each addressing specific technical issues. Each work unit will include the development and demonstration of fully functional brassboard subsystems/software components. The final work unit will include the fabrication and demonstration of an integrated RTLS technology based concept demonstration system encompassing the technologies developed under this task.

The major work units planned for this task will address the following four areas of technology:

1. Optical Subsystem Stabilization: The optical subsystem stabilization work unit will address the development of a low cost, lightweight method of optical stabilization which will make possible more accurate hand-held rangefinding and laser designation at long distances and permit the use of higher magnification optics for improved target identification.

2. High Accuracy Azimuth Determination: The goal of the high accuracy azimuth effort is to reduce azimuth measurement errors to less than 4 milliradians absolute error by developing a more accurate method of automatically determining and applying corrections for the observer's position and for local magnetic anomalies and for providing a simple, fast, and accurate field calibration procedure.

3. RTLS User Interface Development: The RTLS user interface effort will develop a set of user interface concepts demonstrated to effectively incorporate and integrate applicable RTLS sensors, displays, user inputs, etc. The user interface effort will include the development of a simulated RTLS-based system which will be used as a tool for the development and evaluation of alternative user interface concepts/designs.

4. Thermal Imaging/TV/Direct View Integrated Optics: The thermal imaging/TV/direct view integrated optics work unit will include the design and fabrication of a fully functional brassboard optical system which will include a miniature thermal imaging sensor, solid state TV, a direct view optical path, laser detector, and imaging display all sharing the same primary optics. Reflective optics will be used for the primary optical elements.

Summary of Prior and Current Years' Work

Initial programmatic and architectural work was conducted to assist conceptualization and task focus. There were two areas of focus in FY96. The first area of focus was the development of common CCSST hardware systems. Data collected and generated included:

1. Identifying and quantifying the targeting/fire control information needs for the applicable levels of the fire control hierarchy;

2. Identifying and quantifying the capabilities and limitations of CCS technologies currently being used and developed; and,

3. Identifying and quantifying CCSST deficiencies.

The second area of focus in FY96 was to initiate an ongoing CCS technology transfer and integration effort. Related technology development efforts were identified and monitored and, where appropriate, formal relationships/collaborations were established to enable the Marine Corps to benefit from progress being achieved elsewhere. The information developed during the data base and technology transfer efforts will support the subsequent formulation of a comprehensive CCSST developmental strategy.

Full component system and test facilities integration has started.

ASDP. Investigated different types of acoustic processing, purchased hardware components, and wrote/tested software in FY96.

AQHUD. In FY96, a concept definition was written for Avenger and MANPADS HMDs. This was followed by a request for information (RFI) from government and industry. Existing HMDs and head tracking technology were assessed. Off-the-shelf HMDs were selected and procured for integration with Avenger and MANPADS.

PILLAR. The efforts during the first year (FY96) focused on completing a sensor performance specification based on mission requirements and then completing the actual sensor selection and integration.

EAGLE I. During FY96, efforts focused on the development of a highly accurate azimuth/compass system.

Planned Work

Implementation of CCS systems and test bed concepts will continue through FY97. Specific tasks will include the integration of Advanced Processor and Targeting Sensor Technology, development of network and communication links, and enhancements in data/ information fusion, transmission, and display. Additionally in FY97, the Targeting Sensor Test Bed Facility and Operations Range will be implemented. The advanced test bed concepts will be implemented in FY96-97. BAA contracts for CCS Technologies and Technology Exploitation will continue in FY97 and through the outyears.

ASDP. In FY97, system integration will be completed and system performance will be evaluated.

AQHUD. In FY97, a demonstration of the HMD capability will ascertain feasibility and system refinements required for Avenger and MANPADS applications. A system specification will be written to procure prototype HMDs to provide the required operational capability.

The system will be transitioned to the PM for AIR Defense (PMAD).

PILLAR. The second year of the program (FY97) will be the primary sensor build effort with final integration and field test occurring in FY98.

EAGLE I. During FY97, efforts will focus on the development and integration of a highly accurate azimuth/compass system.

Transition Plan

This task will generate several applied research efforts and enhance current, ongoing efforts.

ASDP. This work will be incorporated into the USMC TEAMS Facility.

AQHUD. The potential exists to provide a product improvement to the existing Avenger and MANPADS gunner's helmet. Transition to a USMC ATD and management by the end user, PM C4IAD, is anticipated in FY97-98.

PILLAR. This task will generate a sensor to be tested by Marine units in a field test. The interface between this sensor package and existing computing equipment in the field commanders control station (a computer workstation) will be defined as the mission areas for this equipment solidify.

EAGLE I. RTLS technologies can be transitioned to a wide variety of systems currently under development. Specific transition plans will be developed.

Relationship to Other Programs

An explicit goal of this task is to identify and, where appropriate, establish mutually beneficial and non-duplicative collaborations with ongoing and related Navy/Marine Corps work. Such relationships with several CCSST-related Weaponry Project tasks are planned. In addition, this project is being closely coordinated with the Army labs through working groups and in conjunction with the FXXI LW (and with OPNAV N85 Expeditionary Warfare in conjunction with sea based fire support concepts) to derive maximum benefit from research and development efforts and take advantage of Joint Range/Facility/Program opportunities.

An explicit goal of this task is to identify opportunities for CCS technology transfer. Efforts will be made to identify and take advantage of relevant and ongoing IR&D and other Service's work in this area.

ASDP. This project supports the overall Firepower Imperative, focusing on the USMC TEAMS Facility.

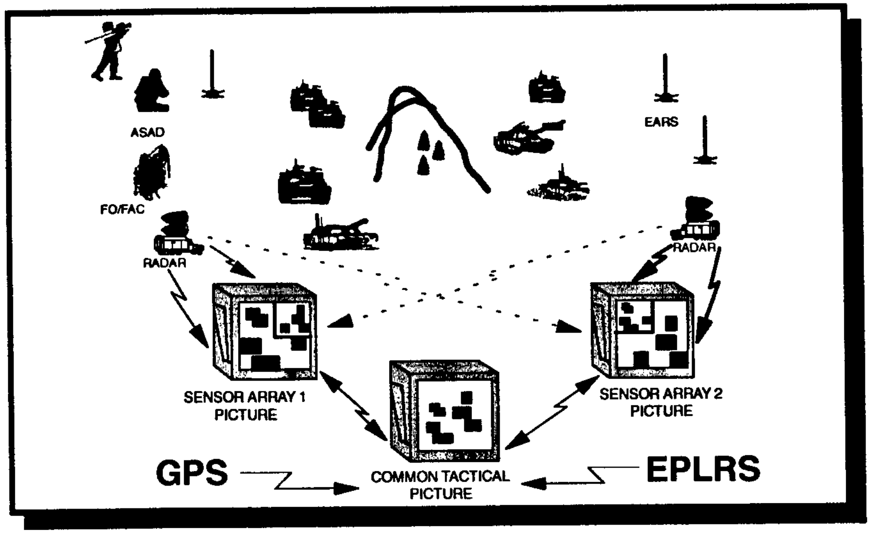
AQHUD. HMDs for the M1A2 main battle tank, M2A3 Bradley Fighting Vehicle, and RAH-66 Comanche Scout/Attack helicopter are being evaluated by the U.S. military. The British Ministry of Defense is considering helmet displays for the Lynx helicopter. A CRT based HMD is in production for the AH-64 Apache attack helicopter. The Army is currently leading the HMD technology development with their Combat Vehicle Crew (CVC) helmet display for tank commanders and Advanced Visionics System (AVS) program which is developing see-through HMDs for rotary winged aircraft. The Army Natick Research &

Development Center (NRDEC) coordinates joint service activities with the Navy, Air Force, NASA, and others to promote HMD developments.

PILLAR. This project will generate a sensor that may be integrated with FXXI LW and the Digital Battlefield.

EAGLE I. This project is related to, and will leverage work being conducted under, the US Army's FXXI LW and Rapid Force Projection top level demonstration programs and technology being developed by the DARPA as well as the USMC FO/FAC ATD Programs.

ADVANCED TARGETING SENSORS



OBJECTIVE:
- IMPROVED WEAPON SYSTEM EMPLOYMENT AND EFFECTIVENESS FOR EXPEDITIONARY FORCES

CAPABILITIES:
- VLO AIR TARGET DETECTION/TRACKING (Y-Q2)
- IMPROVED QUEUING OF MANPORTABLE AAW WEAPONS SYSTEMS (SENSOR ONLY) (Y-Q2)
- ID (GROUND/CAS IFF, AAW IFF) (G-Q1)

APPROACH:
- DEVELOP, TEST, AND INTEGRATE SUITE OF ADVANCED REMOTELY PROGRAMMABLE SENSORS UTILIZING SENSORS CURRENTLY BEING DEVELOPED (ACOUSTIC/EO/SEISMIC/MAGNETIC)
- ADAPTIVELY INTEGRATE AND FUSE TARGET INFORMATION OVER OWN-POSITIVE INFORMATION USING A COMPREHENSIVE COMBAT SYSTEMS INTEGRATION PROCESSING SYSTEM
- INTEGRATE DEVELOPED SYSTEMS INTO TEAMS FACILITY

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
ASAD DEMOS	▲			
FO/FAC TEST/DEMOS	▲	△		
MULTI-SENSOR PACKAGE DEVELOPMENT	▲	△		
SENSOR DATA FUSION DEVELOPMENT		△		△
ASAD IMPROVEMENT	▲		△	
FO/FAC IMPROVEMENT	▲	△ △	△	△

TRANSITION: PM - GROUND WEAPONS

PERFORMERS:
- NSWCDD, NSWCDD-CSS, NAWCWD, A.P. HILL
- ROCKWELL, SYNETICS, HUGHES

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 3. ADVANCED LIGHTWEIGHT GROUND WEAPONRY

Problem/Deficiency

Mobile Automated Fire Support System (MAFSS). As the Marine Corps evolves into the force structure for the next century, it needs mobile and robust fire support for the infantry battalion. With artillery batteries being regarded as high priority targets, it follows that the means of avoiding counter battery fire should receive high priority. In order for indirect fire weapons to survive and be effective, frequent and rapid movement and emplacement, will be necessary. A self-propelled, turreted, automatic feed, 120 mm mortar type weapon that can operate in a "shoot and scoot" environment is needed.

Reactive Breaching Warhead Technology. Since the mid-70's the USMC and the US Army have determined that breaching of concrete and masonry walls is a high priority requirement for military operations in urbanized terrain (MOUT). The major deficiency is the breaching of typical urban walls (8 inch concrete, 12 inch masonry brick or block) which requires warhead and explosive weights far greater than can be carried by the individual infantryman. Supporting arms such as tanks with 105mm guns employing high explosive plastic ammunition containing 15 pounds of composition A3 explosive are incapable of providing man sized breaching holes because of the failure to remove the reinforcing bars (REBAR). The USMC Mission Areas (MAs) 23 (Close Combat), 13 (Security), 22 (Ground Tactical Mobility/Counter Mobilities), and 44 (Engineering) clearly identify the urgent need for breaching technologies to defeat either urban walls or concrete obstacles. MA 23 identifies, as the number one deficiency, the inadequate capability to breach obstacles and, as the number 10 deficiency, the inability to defeat a varied array of targets including bunkers, obstacles, etc. The Marine Corps S&T Roundtable identified the lack of ability to breach man size holes in concrete walls as a critical technology area.

Weapon System Hit Improvements. All existing unguided weapon systems are deficient in accuracy, range, and night sighting. Present guided systems are too expensive. A small arms weapon could benefit from day/night range finding and aiming error compensation sights.

Fire from Enclosure Weapon Technology. Current man portable assault weapons can not be fired from enclosures. Increased urbanization dictates a need for firing from enclosures.

Counter Active Protection Systems. Existing and planned improvements to active protection systems can destroy the effectiveness of present and planned anti-tank missiles.

High Energy/Impulse Warhead Concepts. Enhanced blast/ignition/incendiary high energy/impulse warheads are required to engage and destroy a wide variety of targets. These include personnel structures, logistics, supplies, combat vehicles, and refinery facilities.

Supporting Technology. The future battlefield will require highly lethal and mobile infantry units. Lightweight and durable weapon systems with improved effectiveness will be

needed by Marine combat forces. Technology should ideally lead to the capability of supplying accurate, timely, and lethal fire support from moving platforms.

Technical Objective/Expected Payoffs

MAFSS. The technical problem is to solve the numerous issues associated with integrating a major caliber mortar weapon system into a vehicle that will operate with rapid fire, "shoot and scoot" capability. This effort's primary thrust is to design and demonstrate a very compact and efficient autoloader in a confined space (e.g., turret for infantry vehicle). Also included in this effort is the concept development of high speed weapon lay, integrated digital communication systems, and a fire control system (including ballistic computations) that can eliminate the aiming circles and stakes procedure, and the development of a system configuration that will allow for protection from ground fire and air burst without hampering direct or indirect fire operations.

The expected payoffs are:

1. Very rapid conduct of a fire mission;

2. Reduced vulnerability to counter-battery fire (by system movement even during "adjusted fire" missions);

3. Enhanced mission flexibility for the MAFSS by providing potential for direct fire as well as for future incorporation of guided munitions;

4. Reduction of crew from five to four (near-term) then three (long-term); and,

5. Reduced General Fire Unit Requirement.

Reactive Breaching Warhead Technology. The primary objective of this effort is to develop the warhead technologies to breach urban walls (8 inch reinforced concrete and 12 inch brick/masonry) and destroy concrete barriers with man portable weapons. As identified above in the problem/deficiency statement, wall breaching during operations in urbanized terrain is a major requirement. The lack of the capability to provide man access breaching through concrete walls significantly limits the commanders' ability and the infantryman's mobility by channelizing forces away from the concrete walls/building areas of the city. The ability to sustain the assault momentum of the infantry unit as it moves through the urbanized area would be significantly improved as well as demoralizing for the enemy to realize that breaches in structures could be made thus permitting the friendly forces to use accesses and passageways, etc. not previously available to them. The development of a warhead suitable for man portability permits the carrying of multiple warheads on vehicles and therefore would permit the development of a vehicle weapon which could reduce obstacles/areas rapidly weapons in a sustained movement through a breaching area. Also, this technology would lend itself to other engineering

applications such as rapid protective structure destruction and construction of fighting positions in extreme hard rock or concrete areas. This same technology has possible application to cratering of runways.

Weapon System Hit Improvements. This project will develop inexpensive guidance systems; develop and integrate day/night rangefinding/Army Tactical Missile System (ATACMS) error compensation sighting; and improve range capabilities for weapon systems.

Fire from Enclosure Weapon Technology. This project will develop technologies which permit man-portable assault weapons to fire from enclosures.

Counter Active Protection Systems. This project identifies and develops technologies which will defeat the active protection systems.

High Energy/Impulse Warhead Concepts. This project will develop and investigate technologies which will increase lethality, range, and effectiveness against a wide variety of targets.

Supporting Technology. This effort is to identify technology to support Marine Corps infantry and Light Armored Infantry (LAI) forces. Marine Corps' unique needs will be identified and examined to determine if current US Army or Joint programs are addressing these needs. If not, technology solutions will be sought to fill these needs. The shortfalls or gaps identified will be reviewed to determine the ones with the highest payoff. The most promising, innovative solutions will then be investigated.

The expected payoff will be solutions unique to Marine Corps needs that are not being addressed by other Service efforts. Payoffs of significantly improved performance, lower weight, cost, producibility, high reliability, and quality will be stressed in the selection of technical solutions to pursue.

A proposal for a lightweight 81mm mortar employing composite materials has been selected for pursue. This effort will provide a mortar system with a weight of approximately 45 pounds. This is a greater than 50 percent weight reduction from the current system. The reduced weight will significantly lessen the burden to Marines and increase their mobility and effectiveness.

Technical Background and Approach

MAFSS. The idea of a turreted mortar is not new. The Soviet Union first revealed a turreted, 120mm, self-propelled mortar system, 2S9, in 1985. Late in 1990, they revealed that they had developed the 120mm 2S23 self-propelled howitzer/mortar system. This is essentially a modified version of the turret used with the 2S9 system mounted on a modified BTR-80 (8x8) armored personnel carrier chassis.

The critical technical issue of this effort is the application of a 120mm, rapid fire, turreted mortar with the novel autoloader in the confined space of a modified infantry vehicle, future variant of an amphibious assault vehicle (AAV), or other LAV. Specifically, controlling the recoil loads of the 120mm mortar, developing a breech obturation mechanism, developing a safe ammunition handling system, and defining space allotment for weapon and associated weapon system components (i.e. gun laying systems, communications, fire control etc.) and crew will be analyzed and developed.

The approach to completing the loader design concept is to design, fabricate, and test component parts and assemblies using unique or exploited technologies for handling, transfer, ramming, and extraction of full scale ammunition. The design is an iterative process with modifications being made as dictated by the design of the autoloader and the analysis of the operations within the turret.

The design will work from the mortar breech face backwards to the ramming transfer systems and subsequently to the ready rack, etc., to build the demonstration model. The non-firing model will demonstrate the rate of ammunition loading at actual speed by operating the magazine feed, horizontal and vertical transfer, and the feed, transfer, and ramming of the ammunition. The extraction and ejection of the spent case will also be at actual speed. The total rate of fire will be demonstrated by analysis, i.e., the sum of the demonstrated loading, extraction, and ejection times plus the appropriate firing and recoil times.

Reactive Breaching Warhead Technology. As discussed above, the identification of the target walls in the MOUT was previously accomplished at NSWCDD for the USMC. The use of aluminum liner shape charges against concrete results in a hole volume significantly larger than that normally predicted by the mass of the liner and its velocity especially when compared to similar jets employing copper liners. This effect has been long noted but never exploited. Recent developments in reactive materials against air targets have shown that such materials generate significant amounts of heat and pressure inside the targets where the reaction is initiated by the impact and therefore causes considerable damage to the targets. The effect of the aluminum liners leads one to believe that similar effects may exist in concrete penetration and/or masonry penetration by proper selection of the reactive materials. The technology developments in explosive formed projectiles (EFPs) has resulted in multiple fragments from a single liner being precisely distributed in a pattern. The possibility of combining the reactive material effects inside of concrete structures to generate sufficient overpressure to destroy the concrete and eject outward in both directions would significantly damage the rebar and possibly break and remove rebars. The precise placement of multiple fragments penetrating into the concrete through use of the EFP warhead technology would allow minimization of the materials to obtain maximum destruction in the concrete targets. Therefore, our approach to development of concrete destruction warhead will consist of the following steps: a) the review and survey of the explosive breaching techniques, such as use of linear charges and distributing explosives, to define the present state-of-the-art and the abilities of multiple small warheads to provide breaching capabilities; b) the identification of the reactive materials effects in concrete and masonry with an ultimate objective of identifying the optimum material for defeat of concrete, the investigation of the penetration parameters of the reactive materials, the concrete reaction

parameters of those materials including the investigation of encapsulating materials for explosive launch without reaction and penetration into the target to sufficient depth prior to the erosion of the encapsulate materials and then the initiation of the reactive material; c) an investigation into the damage mechanisms caused by such internal reactive material reacting in the concrete. Scale model testing for both explosive launching techniques penetration and the reaction mechanisms in concrete masonry structures will be conducted as the parameters become known for defeat of the concrete structures by reactive materials. The warhead concept will be designed and, through iterative tests, demonstrated first statically and then dynamically. The warhead will be launched either from an air gun or an existing weapon system to demonstrate the ability of the warhead mechanism to defeat the concrete targets.

Weapon System Hit Improvements. This project will conduct conceptual design studies and technologies identification of subsystems which would address deficiencies, e.g. identify inexpensive guidance concepts and combine day/night/range finding sights. Critical component technologies will be identified and developed. Critical components will be proven or existing systems will be selected to demonstrate improvements.

Fire from Enclosure Weapon Technology. Utilize to the maximum extent possible trade study, conceptual design, existing hardware, and experience gained from prior programs. This project will focus on the development of conceptual "soft-launch" propulsion capabilities. The proposed project will be a multi-phased program with specific exit criteria established for each phase. The program would begin with a market survey and technical literature search to identify any new developments in the field since the completion of the MPIM Proof of Principle (POP) and CPTD programs. Next, a series of performance analyses and trade-off studies would be conducted to identify the best technical approach. This would be followed by a conceptual design and a proof-of-principle hardware fabrication phase. The project will then conclude with a series of concept demonstration flight firings from a representative operational enclosure.

Counter Active Protection Systems. This project will identify promising technology solutions (i.e. radar significant reduction, radar counter measure, jamming pretriggering, etc.) and conduct conceptual design trade studies and analysis. Critical subsystem development and testing will be conducted. Hardware for critical subsystem will be fabricated and demonstrated.

High Energy/Impulse Warhead Concepts. This project identifies concepts and critical component technologies. Analysis will be conducted to establish feasibility of concepts and critical components. Hardware design, fabrication, and testing will be done utilizing existing weapon systems as a test bed.

Supporting Technology. The initial part of this effort is to identify the gaps in Marine Corps infantry needs. Once identified, the status of technology to provide solutions can be evaluated and solutions proposed. A BAA was and will be used to solicit solutions for lightweight weaponry needs identified to support Marine Corps infantry. Only those that will provide high payoff with acceptable risk and which are not being addressed by other programs, will be supported.

Summary of Prior and Current Years' Work

MAFSS. Concepts of an autofeeder were and will continue to be evaluated. An engineering mockup of the most promising concept was fabricated.

Fabrication of the wooden mockup of a LAV hull was completed. The initial turret structure was fabricated in FY93. Investigations in the area of breech obturation were successfully conducted in FY96 by the NSWCDD. Design and fabrication of the mortar system components that interface with the ammunition and feeder system, i.e., breech ring, block, extractors, and the breech area of the barrel, are complete. A breech block compatible with system physical requirements has been obtained. Case modification was completed and testing conducted which verified the extraction concepts thus permitting rammer and ejection components design to proceed. Final demonstration was completed.

Engineering models of the required ammunition exist and were modified and used to verify fit and function of the ammunition feed system. Initial briefings have been given to the potential user, MCCDC and to US Army PM Mortars. A technology roadmap identifying existing, ongoing development and emerging technologies in the communications, fire control systems, tube laying, etc., is being developed. The possibility of joint development of future ammunition is being investigated. Efforts to identify potential vehicles have been completed.

Reactive Breaching Warhead Technology. Industry and Naval activities working in the reactive fragment area have been contacted and solicitation of their assistance in defining the types of materials to be investigated has been initiated. Other alternative materials approaches for the weakening/destruction of the concrete material have been identified and will be further investigated.

Weapon System Hit Improvements. New start FY97.

Fire from Enclosure Weapon Technology. New start FY97.

Counter Active Protection Systems. New start FY97.

High Energy/Impulse Warhead Concepts. New start FY97.

Supporting Technology.

Planned Work

MAFSS. The iterative design approach will continue with the rammer and extraction components, feeding and transfer, vertical and horizontal transfer, and ready rack and magazine feed systems being designed, built, tested, and modified to construct the demonstration loader model. The demonstration of the loader is planned for the fourth quarter of FY96. Efforts to define the technology roadmap in order to complete total fire support system concept and to

identify joint development opportunities will continue. Efforts to identify joint system technology and ammunition developments will continue. The efforts to identify the technologies in communication, fire control systems, location, and gun laying systems will continue with emphasis toward development opportunities for joint development or use of ongoing developments or existing technologies. Efforts will continue to identify interfacing concepts with potential vehicles and develop the detailed user requirements. MAFSS will transition to 6.3 in FY97.

Reactive Breaching Warhead Technology. In FY96 the initial efforts were to identify possible reactive materials to be employed to penetrate and then react inside the concrete to destroy walls and barriers. The initial baseline investigations will include a survey of the materials, estimates of the penetrating capability of the materials, estimates of the reaction requirements inside the target, and estimate of the destruction capability of the fragment. After identification of the initial materials and possible requirements for encapsulation for explosive launching and/or concrete penetration depths, an initial concept warhead design will be formulated.

The penetration codes for fragments and/or small arms bullets will be employed to predict the depth of penetration of the various reactive materials and the penetration parameters such as the penetration time, pressure of both the concrete material and penetrating material during penetration, the penetration mass, and velocity, to determine the initial impact conditions which will lead to the material reaction after penetration. These codes will identify whether encapsulants of the reactive materials are needed and, if so, the approximate amounts to be eroded during penetration to initiate the reactions. In FY97, small scale single fragment testing of several materials may be conducted at various conditions to evaluate the materials and the encapsulants required for penetration into the concrete. Also, the parameters required for explosive launching of the materials may be investigated by testing of various materials in small scale explosive launch tests. After identification of materials, the encapsulants, if necessary, and the parameters for single fragment impacts (such as the mass, velocity, penetration depth, etc.), the concrete destruction parameters (hole size, depth and destruction area, weakened area of the concrete, etc.), and the feasibility of a single warhead to launch multiple fragments to create breaching holes will be investigated. As part of the warhead conceptualization, the interaction effects of the fragments will be ignored for the initial determination of the patterns and number of fragments. In the following years, it is planned to continue the initial investigations to identify the optimum materials and fragment configuration, fragmentation pattern, numbers of fragments, material optimization for both encapsulants and launching, penetration, target destruction, and warhead designs. In FY98, several design iterations are planned in the warhead design effort. First, the warhead will be designed and testing will be conducted statically, culminating in a static warhead demonstration against an 8-in concrete wall. Additional design efforts will be conducted to ensure that the warhead, when dynamically fired at velocities normally launched from a man's shoulder and/or higher velocities, will perform in a desired manner through a dynamic testing demonstration.

Weapon System Hit Improvements. In FY97 critical technologies will be identified, analyzed, and selected for incorporation into components and systems. A conceptual subsystem

design will be started and critical parameters investigated. In FY98, subsystem design will be completed and component testing will begin. Critical parameters will be identified, component testing completed, and system integration, with demonstrations of hardware, will take place in FY99. The proof of principle demonstration will take place in FY00.

Fire from Enclosure Weapon Technology. In FY97, critical technologies will be identified and analyzed. Critical parameters will be investigated, hardware will be selected, and component testing will be conducted in FY98. In FY99, hardware will be fabricated and demonstrated and a final technical report will be produced.

Counter Active Protection Systems. In FY97, critical technologies will be identified. Trade studies and analysis will be conducted and critical subsystems will be developed in FY98. In FY99, critical subsystem hardware will be fabricated and demonstrated and a final technical report will be produced.

High Energy/Impulse Warhead Concept. In FY97, concepts will be identified. Concepts will be analyzed and warhead design, fabrication, and static testing will be conducted in FY98. In FY99, test results will be analyzed and warhead improvements will be implemented. Static and dynamic warhead testing will be conducted in FY00 and a final technical report will be produced in FY01.

Supporting Technology. The primary effort in FY97 will be to continue the initial phase (Feasibility Study) of the contract for the lightweight 81mm mortar, evaluate the results of the first phase, and begin the second phase (Development and Verification), if acceptable results of phase one are achieved.

Work will continue with the user on developing requirements and a transition plan and schedule.

Transition Plan

MAFSS. MAFSS will transition to 6.3 in FY96. The schedule of follow-on transitions to a fielded system is dependent upon sponsor priorities and funding levels. Potential sponsors include the Navy, Marine Corps, and Army as this effort addresses a compact, lightweight, automatic gun loader system which is directly applicable to naval gun mount problems and any lightweight armored vehicle that needs a mobile fire support with a major caliber weapon system. Identification of potential joint development opportunities will be emphasized.

Other ALGW. Technology will be demonstrated in concert with existing infantry weapons such as the Shoulder Launched Multi-purpose Assault Weapon (SMAW), the DRAGON, the PREDATOR, and/or the US Army (MPIM/SRAW). Possible opportunities exist as a follow-on effort to develop an obstacle removing weapon system employing multiple warheads in a gun or rapid missile launcher for combat vehicles for breaching multiple obstacles. Efforts will be initiated with the PMs for such weapons to include this warhead technology as

part of the pre- P^3I efforts. During FY97, a transition plan for each project will be developed based on the initial phase, progress of the second phase, funding estimates and availability, and requirements.

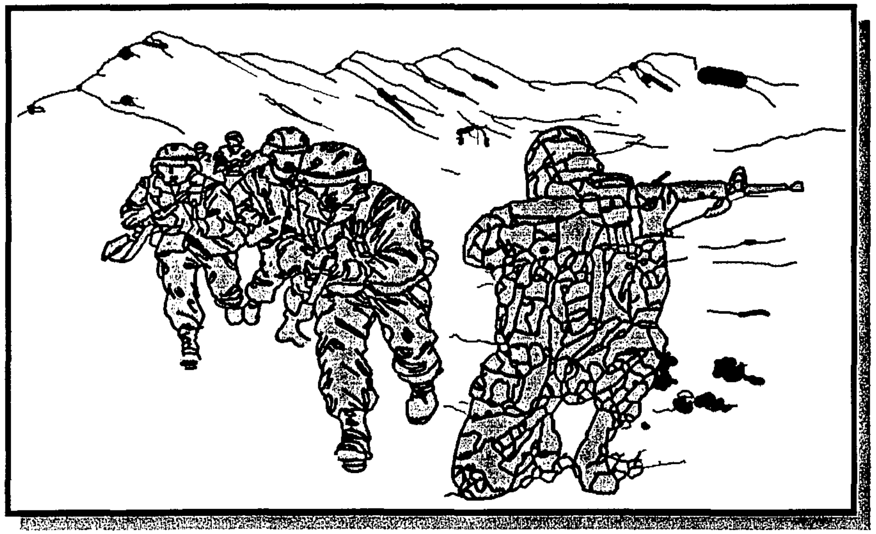
Relationship to Other Programs

MARCORSYSCOM personnel routinely participate and coordinate activities with the Joint Services Small Arms Program (JSSAP), Joint Services Medium Caliber Automatic Cannon Technology (JMAT), Soldier Enhancement Program, FXXI LW, Joint Mission/Support Area and Joint Littoral Warfare Surface Battlespace. This effort supports Joint Director of Laboratories Reliance category 3A programs.

The US Army is studying the feasibility of a turreted mortar, i.e. a mortar system under armor, and developing a system for foreign countries. The concept system will embody the latest advances in existing field artillery equipment methods of fire control and navigation, but is **manual feed vice automatic**. Martin Marietta and Delco/Royal Ordnance are currently each developing 120mm turreted mortar systems configured on an LAV. None of these systems incorporates an autoloader. Other applicable US Army and industry efforts are presently being identified.

THIS PAGE INTENTIONALLY LEFT BLANK.

ADVANCED LIGHTWEIGHT GROUND WEAPONRY (ALGW)



OBJECTIVE:
DEMONSTRATE TECHNOLOGIES LEADING TO INCREASED RANGE, LETHALITY AND ACCURACY OF WEAPONS SYSTEMS

CAPABILITIES:
- DEFENSIVE WEAPONS CAPABILITY (G-Q1)
- INCREASE RANGE (G-Q1)
- INCREASE SHOOTER MOBILITY (G-Q2)
- FIRST ROUND ON TARGET (G-Q2)

APPROACH:
- SURVEY TECHNOLOGY EFFORTS (RFI, BAA)
- INTEGRATE SUBSYSTEMS INTO SINGLE, LIGHTWEIGHT ENSEMBLES
- DEMONSTRATE AND EVALUATE NEW AND EMERGING TECHNOLOGIES
- LEVERAGE ARMY, OTHER DOD, NON-DOD TECHNOLOGIES
- JOINT EFFORTS WITH ARMY

PERFORMERS:
- NSWCDD, U.S. ARMY ARDEC
- AAI, ALLIANT TECH

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
DEFINE TECHNICAL CONCEPTS	▲	△	△	△
120MM AUTOLOADER DEMO	▲ ▲			
BREACHING DEVELOPMENT		△	△	

TRANSITION:
- PM GROUND WEAPONS, JSSAP

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 4. BATTLEFIELD MARKER PANEL

Problem/Deficiency

The need exists for the pilots of CAS and Close In Fire Support (CIFS) aircraft to rapidly and accurately acquire ground targets. Current methods for designating targets are inadequate. Particularly the artillery delivered methods can, depending on the situation, be of marginal value. They can be obscured in the battlefield clutter or lost in the uniformity of the desert/tundra. The target marking problem is both a day and night concern. Additionally, the requirement exists to provide tactical control measures that pilots can easily identify from altitude. Examples would be fire support coordination line or boundaries. Providing the Marine with a vastly improved target marking system, either hand, mortar, artillery, etc., emplaced, will enhance the combined arms effectiveness of the MAGTF.

Technical Objective/Expected Payoffs

The BMP will be configured such that the force commanders can readily mark terrain via artillery fired munitions. The unique terrain marking capability of the BMP will provide for a longer duration marker than is realized by using M485A2 illumination rounds which provide illumination for about 90 seconds.

In addition, with the M110 White Phosphorous (WP) Smoke/Marking round now obsolete, the terrain marking capability for the armed services is severely deficient, bordering on nonexistent. The M110 round was used as a day marker. If utilized in conjunction with the M485A2 illumination round, it could function as a night marker. However, in many scenarios, WP smoke rounds were relatively ineffective as terrain markers for CAS/CIFS coordination.

Several variables beyond the pilot's individual proficiency contribute to his inability to acquire a target. The pilot's FOV is limited by his low altitude and limited tracking time. The marker, generally, is not in close proximity to the target. A marking smoke may dissipate or be displaced by the wind prior to the pilot arriving at the attack site. WP marks are often obscured by other battlefield smoke/dust. Even laser designators are not reliable as they can easily be diffused and spot-trackers cannot function outside of strict run-in relationships.

Research and development of the BMP system is expected to be a medium to high risk effort but with a very high potential payoff in improved threat acquisition and reduction in "friend on friend" casualties.

The BMP marking concepts will provide for enhanced target designation for day/night combined arms operations by optimizing marker/terrain contrasts for CAS/CIFS. The BMP will extend the target marking duration for much longer periods; generally 5 to 30 minutes.

In addition, this system will focus on enhanced terrain marking contrast so that combat identification and target acquisition by fixed/rotary wing CAS aircraft can be markedly improved, regardless of emplacement method.

Technical Background and Approach

The BMP technology lies in developing the appropriate technology to support the pilot of close support aircraft. His ability to accurately locate the BMP target marker in the heat of battle is the essence of this concept. Consequently, targeting the parameters that enhance visual acquisition by the pilot in multiple environments is the ultimate objective of the BMP if it is to be operationally effective.

The initial technical approach was to provide an artillery delivered marking round by utilizing hardware currently in the Army inventory. The first approach involved a two-component, liquid, chemiluminescent payload. Subsequent evaluations were conducted using a 2-D, three concentric ring, mylar tarp; a 3-D marker; reflective sheets; an electro-optical strobe light system; as well as, the chemiluminescent system. The projectile effort concluded at the end of FY94.

Further development efforts were centered around designing and engineering a Hand Deployable Marker (HDM) as a substitute for the bulky VS-17 panels. Potential applications of the HDM in tactical operations include marking landing zones (LZ) and drop zones (DZ), search and rescue operations, marking forward locations, and marking lines of departure.

Summary of Prior and Current Years' Work

The BMP concept development program was initiated February 1992. Work included developing a technical database for improved target marking concepts. Some of the concepts explored included two-component chemiluminescent night markers, luminescent colored day markers, luminescent discs, and reflective mylar sheets.

In the third quarter of FY93, static field tests were conducted at the Edgewood Research, Development, and Engineering Center (ERDEC) M-Field on the BMP concepts. The objective of the tests was to determine the acquisition range of several marking round concepts at altitudes of 100-10,000 feet. The field tests' aerial observations were supported by the Army National Guard Aviation Support Facility, the Maryland Air National Guard Aviation Support Facility (which provided AH-1 helicopter), and the Maryland Air National Guard 104 Fighter Squadron (which provided A-10 aircraft). The reduced data showed the concentric ring tarp and the strobes were easily acquired by the pilots. The concentric rings were the better day marker and the strobe markers were the better night markers. The chemiluminescent materials did not provide the expected results during testing and additional testing was planned for the next quarter. The retest of the chemiluminescent revealed the various intensities of the mixture produced a

variation in reaction time. The ultra high and medium high intensities produced a longer signature than the spike ultra high intensity mixture.

The BMP technology concepts were evaluated in the first quarter of FY94 at the Dismounted Battlespace Battle Lab (DBBL), "Own the Night", Advanced Warfighting Experiment (AWE) at Ft. Campbell, Kentucky. The objective of the exercise was to test and evaluate technologies on their ability to enhance the capabilities of the combined forces to effectively fight at night in a visibly dark battlefield. The DBBL evaluated developmental technologies and Nondevelopmental Items (NDI) that will be employed in target acquisition and attack from infantry soldier to the larger airborne and ground assets. The BMP concepts were evaluated in several static field tests in a controlled environment involving a ground team consisting of FAC and Army AC-130 aircraft, an Air Force A-10 CAS aircraft, and a pair of USMC UH-1 rotary wing aircraft. The aircraft flew various tactical passes and recorded the acquisition range as they observed the marking concepts. The pilots used passive Generation III (GEN III) AN/AVS-6 near IR aviator night vision goggles (NVG), low level light television (LLTV), as well as the naked eye to acquire the marker concepts. The BMP concepts performed well in the static environment and had positive comments from the CAS personnel. Further research and development efforts are needed to refine the concepts to obtain an integrated prototype for dynamic testing. Based on conversations with aviators, Aviation Liaison Officers and Aviation Naval Gunfire Liaison Companies feedback at the DBBL exercise about the use the VS-17 panels for marking LZ/DZ, the BMP program has since embarked on a spin off development of a Hand Deployable Marker in addition to the ongoing day/night marker program.

In a static field test conducted during the third quarter of FY94, the BMP team evaluated the improved BMP concepts. The contractors upgraded their prototypes based on information learned from previous static field tests. The objective of the tests was to measure the contrast and background luminance of the individual concepts and the field and sky backgrounds using a photometer. In addition, the strobe lights were evaluated with GEN III AN/AVS-6 NVGs at various distances to determine at which intensity and flash rate the goggles gain control was affected. A UH-1 observation was conducted during the day portion of the test. The improved strobe prototype showed marked improvement in acquisition range along with the 3-D marker. The data was reduced and results were compared to previous static testing. Testing and evaluation of the artillery delivered concepts concluded in FY94.

In FY95 all work centered on the design, engineering, and testing of the Hand Deployable Marker. The Force Command (FORSCOM) Science Advisor has requested the BMP team take the lead in evaluating the addition of thermal capabilities to the VS-17 panel. The panel used for marking LZs and DZs is difficult to acquire from the air during inclement weather conditions and does not have a night signature. The National Training Center (NTC) has prepared an Operational Need Statement which is being staffed through FORSCOM, the Pathfinder's School and the SOCOM. Ongoing dialogues will be established for their support during engineering and operational field testing and evaluation.

A CNP, based on a British NDI, titled "Covert Light System" was submitted under the Army's Foreign Comparative Testing (FCT) program. The CNP is a collaborative effort with the

DBBL. This NDI system was evaluated by the BMP team on its potential to adapt an IR night capability to the HDM and for the VS-17 panel. The NDI system earned high marks at the Ft. Campbell exercise.

In FY96 an Analysis and Final Report on the project was prepared.

Planned Work

This project transitioned in FY96.

Transition Plan

The HDM was transitioned to the USMC PM-CSS where design and engineering efforts will continue. An effort will be made to integrate the Hand Deployable Marker with the FORSCOM task, as well as adapt the FCT. The integrated design will be finalized for preparation of an Engineering Change Proposal (ECP) to the VS-17 panel based on information gathered from all users. The ECP documents will be forwarded to the item manager for inclusion to the DoD inventory.

Relationship to Other Programs

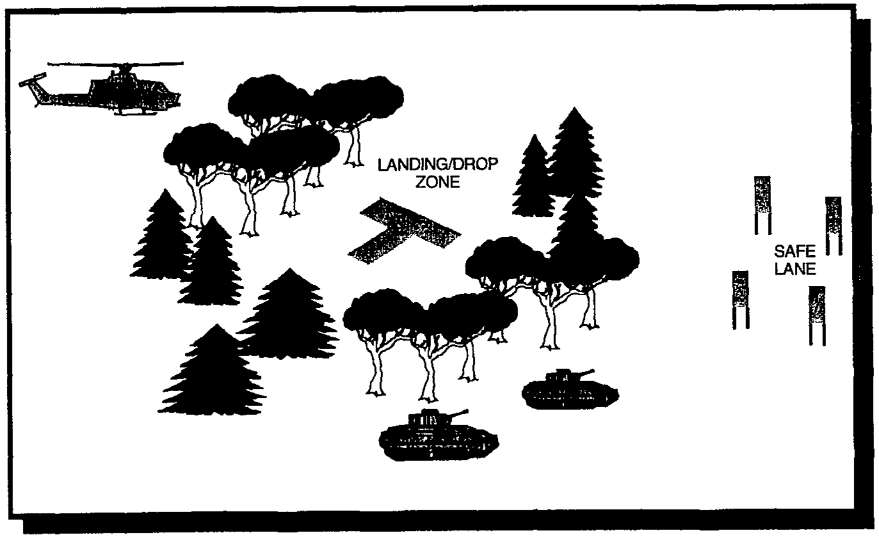
The BMP target marking objectives/requirements are consistent with the signal/marking requirements identified in the US Navy's 2.75-inch Rocket Master Plan.

The HDM is directly related to a FORSCOM Field Assistance in Science and Technology task with ERDEC to add a thermal signature to the VS-17 marker panel. Information gained from the testing of the British NDI under the FCT program can also be applied to the Hand Deployable Marker.

Previous IR&D work performed by Foster Miller, Inc. has supported the initial HDM technology. A meeting will be coordinated with the NTC, DBBL, Pathfinders, FORSCOM, SOCOM, USMC, and ERDEC on the merit of upgrading the applications of the Hand Deployable Marker and the VS-17 panels.

The US Army Combat Identification System is currently exploring technologies similar to BMP concepts for facilitating the IFF. DARPA technical and programmatic augmentation is anticipated to address technical challenges beyond the scope of work of this contract.

BATTLEFIELD MARKER PANEL (BMP)



OBJECTIVE:
- IMPROVEMENT OF CURRENT BATTLEFIELD MARKING SYSTEMS

CAPABILITIES:
- ID (CO-OP AND NON-COOP IFF) (G-Q1)
- CO-OPERATIVE ENGAGEMENT (G-Q2)
- AFFORDABILITY/REDUCED MAINTENANCE (G-Q3)

APPROACH:
- HAND DEPLOYED MARKER PANELS
- THERMAL AND VISUAL CONTRASTS
- TECHNICAL AND OPERATIONAL TESTING
- MATERIAL DEVELOPMENT
- IR IMPROVEMENT TO THE VS-17 PANEL
- JOINT WITH ARMY

PERFORMERS:
- ERDEC, FOSTER MILLER INC.

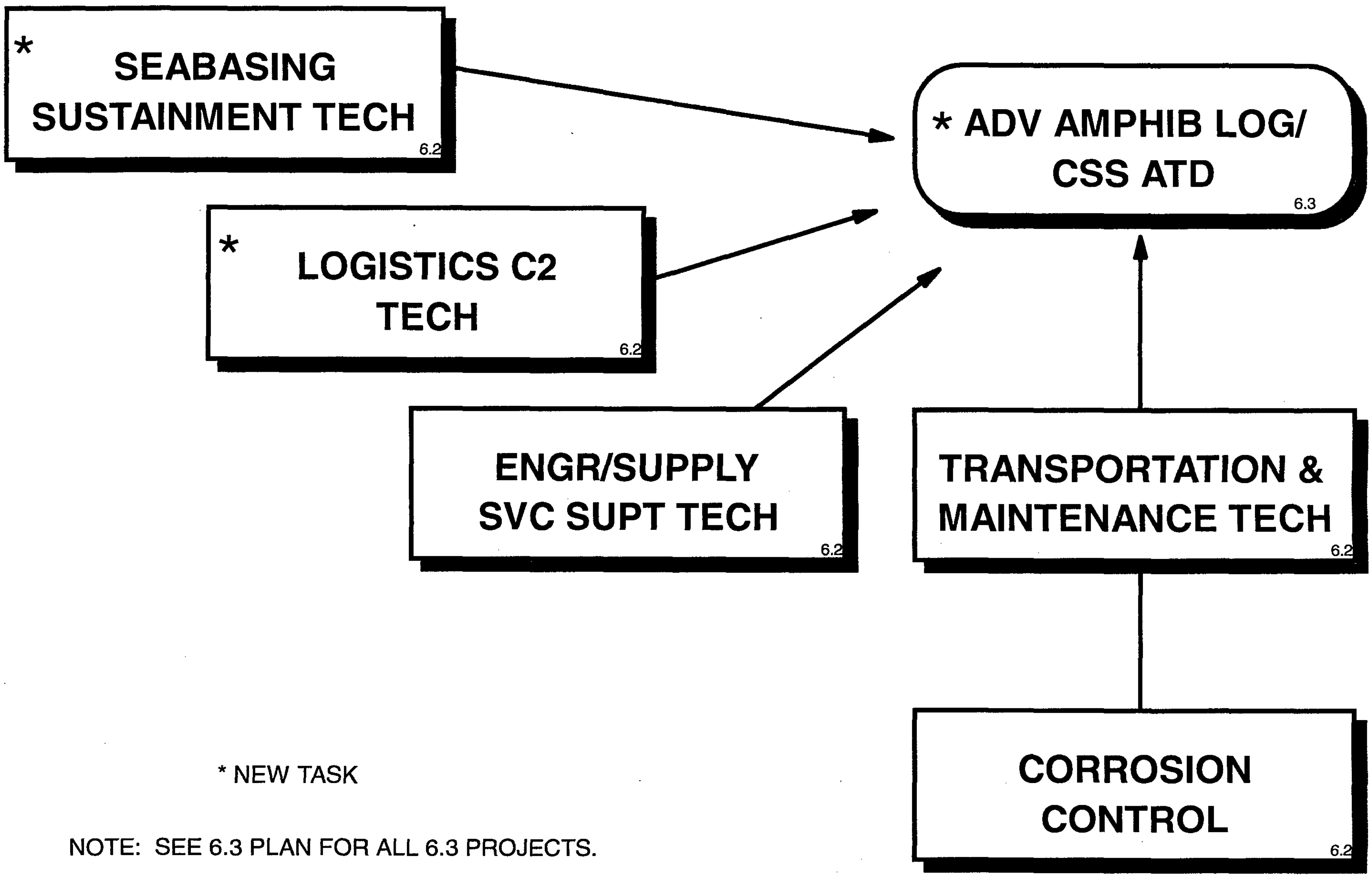
SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
MATERIAL DEVELOPMENT	▲			
DESIGN, FABRICATE AND TEST MARKER PANEL	▲—▲			
OPERATIONAL TESTING	▲▲			
PRODUCE A WORKING PROTOTYPE	▲—	△		
FIELD TESTS WITH II NIEF/NTC/ARMY		△—△		
TRANSITION BMP TO PM		△		
ENGINEERING CHANGE PACKAGE TO THE VS-17		△		

TRANSITION:
- PM CSS/US ARMY PM SMOKE

THIS PAGE INTENTIONALLY LEFT BLANK.

COMBAT SERVICE SUPPORT IMPERATIVE



* NEW TASK

NOTE: SEE 6.3 PLAN FOR ALL 6.3 PROJECTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

Imperative Title: COMBAT SERVICE SUPPORT

THIS PAGE INTENTIONALLY LEFT BLANK.

COMBAT SERVICE SUPPORT IMPERATIVE

PROJECT OBJECTIVES AND TECHNICAL THRUST

Emerging OMFTS and seabasing concepts significantly impact logistics functions. Studies have shown that the demands for a given operation far exceed the current CSS capabilities resident within the Marine Corps. For the Marine Corps to remain flexible, relevant, and responsive to world-wide challenges and to maintain the tactical mobility and responsiveness in all likely scenarios and against any threat, an effective and technologically advanced logistics system must be developed. The primary objective of the CSS imperative is to demonstrate the feasibility of advanced technologies which increase the effectiveness of the Marine Corps in performing their designated missions. These enhanced mission capabilities can be characterized as improvements in: mobility; speed; range; payload; off-load/on-load capability; RAM-D (i.e., increase reliability, decrease maintenance); and, government cost of ownership. This program contributes to the overall goal of enabling the Marine Corps to successfully support and sustain operations across the spectrum of conflict, with a focus towards OMFTS and seabasing.

STRUCTURE AND TASK IDENTIFICATION INCLUDING OUTYEAR NEW STARTS

This project directly addresses known and envisioned shortfalls in Marine Corps logistics systems. The key shortfalls were identified through the S&T Roundtable process, wargame results, and through on-going studies of Marine Corps' future operational concepts. Four tasks are specified in FY97 to address specific logistics system deficiency areas within this imperative. These tasks are: Seabasing Sustainment Technology (SST); Engineering/Services/Support Technologies (ESST); Logistics Command and Control Technologies (LCCT); and, Transportation, Maintenance, and Corrosion Control Technologies .

Seabasing Sustainment Technologies

This is an on-going study of the logistics structure, demands, and capabilities. It continually identifies problem areas and concepts through systems engineering, analysis, M&S, and IPTs. Also, within this task is the rapid prototyping of a seabased C2 system. Logistics wargaming is supported. Technology opportunities and technology concept integration of all logistics tasks are monitored to insure the stated objective is met. Finally, the CSS Warfighting Imperative roadmap is established and maintained within this task.

Engineering/Services/Support Technologies

This task addresses new equipment and materials concepts for expeditionary engineering functions such as bulk liquids, construction, material handling, resupply, and packaging. A prototype meteorological hydrogen generator is underway as well as a prototype ISO container handler. A concept for USMC engineering functions in the 2010 timeframe is being investigated.

Logistics Command and Control Technologies

Four new sub-tasks will provide C2 technologies for Logistics affecting all levels; strategic, operational, and tactical. Efforts are initially focused on rapid request technologies, CSSOC technologies, and commodity planning tools.

Transportation, Maintenance, and Corrosion Control Technologies

This task consists of two major sub-task efforts.

Expeditionary Logistics Vehicle Technology (ELVT). The goal of this task is to develop logistics vehicle concepts, technology, and M&S analysis tools that enhance the overall logistics operations in support of OMFTS. Future Marine Corps operations will cover wider areas, require stealthy presence, and consist of smaller, more dispersed organizations. Adequately supplying logistical support to these forces will be a challenge that will require innovative assets and high technology. Sustaining the initial and follow-on echelon forces conducting these new operations require transportation assets with increased mobility, lift, range, and ship-to-objective capability. This task examines these goals and develops new vehicle and logistical asset concepts to meet the challenge. Required technology is identified, developed, tested, and demonstrated in actual operational scenarios. Whenever possible, M&S tools are utilized to conduct virtual prototyping and operational assessments.

Corrosion Prevention and Control (CPAC). The goal of this task is to minimize or eliminate the corrosion related degradation of current and future Marine Corps systems. This task is broken down into a three-phased approach. The first phase focuses on the inspection and data collection of current fleet corrosion problems. Data gathered during these inspections will be used to identify common problems and their causes throughout the FMF. The origin of the problem will be categorized as to whether it is material, coatings, applications, maintenance, or training. The second phase will investigate new and innovative CPAC technologies and systems. That includes research and testing of new materials, coatings, and application techniques to determine their operational suitability and effectiveness. The last phase is directed toward influencing new system designs, establish new maintenance procedures, and assist in changes to existing training and maintenance doctrine.

Future starts to support the identified shortfalls include:

a. Expeditionary Maintenance Technologies (EMT). This task will address new techniques in maintaining and repairing equipment during the OMFTS scenario.

b. Expeditionary Cargo Handling Technologies (ECHT). This task will address new techniques for shipboard material handling and control during the OMFTS scenario.

c. Convoy Control Technologies (CCT). This task will address all aspects of convoy control in various OMFTS scenarios, to include both logistics and C2 interfaces.

A comprehensive 2-year study identified and prioritized a list of 19 technology shortfalls that are to be addressed over a period of years. The technology roadmap developed and maintained under Task 1 is the management tool which controls the pace and integration of technologies as well as the transition and synchronization of Marine Corps funded efforts with complementary/compatible programs in other Services. The pace of these efforts will be a function of funding availability, changing needs, opportunity, and decisions of leadership. The technology roadmap is updated regularly to compensate for these changes and to optimize investments in technological opportunity. It is initially set up so that in most years there are four to five funded tasks in different stages of development. All the tasks will focus on solving the CSS deficiencies and shortfalls that will allow the Marine Corps to logistically support OMFTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

COMBAT SERVICE SUPPORT IMPERATIVE FUNDING ($K)

TASK NO	PERFORMER	FY96 CURRENT FY	FY97 EXECUTION FY	FY98 BUDGET FY	FY99 BY+1 FY	FY00 BY+2 FY
1	NFESC	0	75	100	50	100
	NSWC/CD	0	485	450	300	300
	NSWC/DD	0	40	50	50	50
	NCCOSC	0	745	400	300	250
	CONTRACTOR	575	255	400	300	300
2	NFESC	1115	1030	800	800	500
	CONTRACTOR	735	550	546	1200	950
3	NFESC	0	250	300	150	300
	NCCOSC	0	425	570	550	600
	CONTRACTOR	0	400	485	439	900
4	NSWC/CD	0	175	470	550	420
	WES	0	0	50	100	50
	CONTRACTOR	0	1150	1075	1000	1180
PROJECT TOTALS		2425	5580	5696	5789	5900

TASK NO.	TITLE
1	SEABASING SUSTAINMENT TECHNOLOGIES
2	ENGINEERING SUPPLY SERVICES TECHNOLOGIES
3	LOGISTICS COMMAND AND CONTROL TECHNOLOGIES
4	TRANSPORTATION, MAINTENANCE, AND CORROSION CONTROL TECHNOLOGIES

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMBAT SERVICE SUPPORT

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. SEABASING SUSTAINMENT TECH														
A. Seabasing/TACLOG Technologies														
(1) Requirements Analysis					S	C								
(2) Concept of Operations						S	C							
(3) Software Design					S			C						
(4) Rapid Prototype Development						S		C						
(5) Rapid Prototype Demonstration								DR						
(6) Prototype Development									S		C			
(7) Prototype Demonstrations										D		DRT		
B. Modeling and Simulations					S			R				DR		
C. Technology Roadmap Update					S			R				R		
D. Seabasing IPT					S			R				R		

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

__ Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMBAT SERVICE SUPPORT (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. ENGINEERING, SUPPLY, SERVICES TECHNOLOGY														
A. Throughput Modeling				R				R				R		
B. Engineering Construction/MHE (1) Container Handler (2) Soil Stabilization (3) Construction								R				HR		
C. Utilities (1) Washdown (2) Climate Control (3) Power Distribution (4) Health/Hygene								R				HR		
D. Bulk Liquids (1) Transportation (2) Storage (3) Protection								HR						
E. Systems Engineering								R						
F. Resupply Technologies (1) Packaging (2) Aerial Delivery								HR R				HR		

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

___ Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMBAT SERVICE SUPPORT (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. LOGISTICS COMMAND AND CONTROL														
A. CSSOC Technologies														
(1) Requirements Analysis					S	C								
(2) Concept of Operations						S	C							
(3) Software Design					S			C						
(4) Rapid Prototype Development						S		C						
(5) Rapid Prototype Demonstration								DR						
(6) Prototype Development									S		C			
(7) Prototype Demonstrations										D		DRT		
B. Commodity Planning Tools														
(1) Requirements Analysis					S	C								
(2) Concept of Operations						S	C							
(3) Software Design					S			C						
(4) Rapid Prototype Development						S		C						
(5) Rapid Prototype Demonstration								DR						
(6) Prototype Development									S		C			
(7) Prototype Demonstrations										D		DRT		
C. Rapid Request CSSC2														
(1) Requirements Analysis					S	C								
(2) Concept of Operations						S	C							
(3) Software Design					S			C						
(4) Rapid Prototype Development						S		C						
(5) Rapid Prototype Demonstration								DR						
(6) Prototype Development									S		C			
(7) Prototype Demonstrations										D		DRT		
D. Logistics Anchor Desk														
(1) Functional Requirements Analysis					S		CR							
(2) Identify Access Requirements & Protocols					S	CR								
(3) Investigate Potentials for Integration with IMCOC & GCCS							S	CR						

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMBAT SERVICE SUPPORT (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS) 1	2	3	4	FY97 EXECUTION YEAR (QUARTERS) 1	2	3	4	FY98 BUDGET YEAR (QUARTERS) 1	2	3	4	FY99 (BY+1)	FY00 (BY+2)
TASK 4. TRANSPORTATION TECHNOLOGY														
A. Expeditionary Logistics Transfer (ELT)														
(1) Award Multiple Contracts	S		C											
(2) Technology/System Assessment			S		CR									
(3) Concept Development				S	O(1)			C						
(4) Preliminary Design					S			C O(1)	R					
B. Plan for ATD														
(1) Prepare Solicitation					S			C						
(2) Transition									T					
C. Transportation Technology Development														
(1) Analysis					S			C			S		C	
(2) Preliminary Design										S			C R	
(3) Test/Demonstration													S	C R
D. Corrosion Control R&D														
(1) Inspection/Problem Identification				R				R				R	R	R
(2) Technology Transfer/Design Analysis				R			R				R			
(3) Evaluate New Materials/Concepts	D		R H			H	R	H		H	R			
E. Lightweight Cooling Component Development														
(1) Design/Fabricate/Test Modular HMMWV Radiator	S		C S		H		D	C		T (PE26624M)				
F. Inductive Coupler Systems		O (2)	T (PE63640M)											

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

— Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:
1. In-process Review
2. Terminate Contract

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 1. SEABASING SUSTAINMENT TECHNOLOGIES

Problem/Deficiency

The emerging OMFTS and Seabasing concepts significantly impact logistics functions. Under the OMFTS scenario, supplies need to be moved from a seabase to multiple delivery points inland. The Hunter Warrior AWE scenario is a more clearly defined subset of these concepts, focused on very small, highly maneuverable, fire teams requiring seabased logistics support. Currently, the demands for a given operation far exceed the capabilities resident in the Marine Corps CSS system. These problems are further compounded by the reduction in forces and anticipated loss of major amphibious lift assets such as the Landing Ship Tank (LST), Landing Craft Mechanized (LCM), and Landing Craft Utility (LCU). This task will continually analyze the problem areas and identify seabased technologies that will close the gap between seabasing capability and demand.

Technical Objective/Expected Payoff

This task will continually expand the Logistics program to accommodate a full spectrum of operational concepts and address the logistics shortfalls of each. A logistics technology roadmap will be continually updated to reflect the guidance of the Roundtable process. Seabase modeling, C2/Tactical - Logistical (TACLOG) prototyping, and the Seabasing IPT will also provide input to the technology roadmap, identifying opportunities for specific technology work. This task will coordinate all efforts to logistically support future expeditionary operations.

Technical Background and Approach

OMFTS and Seabasing have logistics significance to many capabilities: command and control of MEF operations completely from ships; deployment, transport, and project landing forces in sufficient strength and capacity to conduct MEF level amphibious assault operations; mobility to execute ship to objective maneuver including landing craft, combat vehicles, and vertical assault craft sufficient to penetrate the coast and maintain tempo; quick reinforcement of amphibious operation with one or more MPF squadrons; rapidly backload amphibious ships; operation of sufficient MAGTF aviation; and establishment of limited facilities and dumps to provide push logistics when required. These are described in detail in FMFMRP 14-21. Further information is detailed in FMFMRP 14-24, requiring lift capability, vertical maneuver force capability, combined arms capability, landing force maneuver capability, and logistics capability to provide sufficient CSS to rapidly maneuvering elements ashore directly from a seabase.

Sufficient CSS for a rapidly maneuvering element ashore will require reduction in consumption by forces ashore, including that achieved by increased seabasing of logistics, C2 and fire support elements. It will also require improvements in logistics command and control in

delivery procedures. Under this task, these capabilities will be explored, defined, and conceptualized as a system. Techniques of IPT, M&S, and rapid prototyping will be employed.

Summary of Prior and Current Years' Work

In FY95, accomplishments included the following:

a. Development of a transportation/distribution M&S tool;

b. Parametric studies of heavy lift air delivery vehicles;

c. Completion of a preliminary technology roadmap for logistics technologies; and,

d. Development of a concept overview for Marine Corps 2010 Logistics.

In FY96, accomplishments included the following:

a. Addition of Transportation and C2 work areas to the CSS program;

b. Expansion of the Marine Corps 2010 Logistics overview to include Other Expeditionary Operations (OEO), Sustained Operations Ashore (SOA), and OMFTS;

c. Multiple simulations and analysis of CSS distribution alternatives;

d. Formation/Charter of a Naval IPT for Seabasing Technologies; and,

e. Addition of Systems Engineering tasking for CSS.

In FY97 new starts include the seabase modeling, the seabase IPT, and the seabasing TACLOG technologies.

Planned Work

This task will continually evaluate industry, university, and other laboratory proposals to address CSS shortfalls. A logistics technology roadmap will be continually updated to serve as a roadmap for technology selection and schedule. This will be accomplished using M&S techniques for wargaming to analyze effects of introducing innovative technology concepts. As technology opportunities are identified, the specific technology work will be assigned to the appropriate task. This task will coordinate all efforts to logistically support future expeditionary operations. Included will be the rapid prototyping of a seabased C2 system, a seabase model of logistics functions, and an expansion of the FY95 Logistics 2010 study to include OEO and SOA.

The Seabasing Tactical Logistics Technologies sub-task is also a new start for FY97. In this sub-task, we will investigate communications, personnel, and computer systems requirements for the "2010" new ship defined for seabased logistics. A physical architecture and CONOPs will be defined and technology will be identified to support those requirements. Initial supporting developments will also be made.

Transition Plan

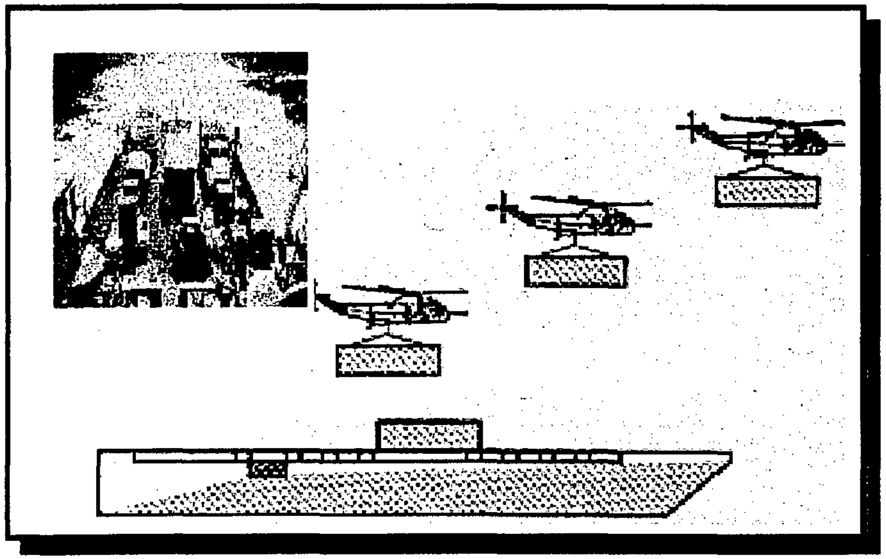
It is anticipated that the C2/TACLOG technology in this task will transition to the C4I Directorate, MARCORSYSCOM. The modeling and IPT efforts will contribute to the Roundtable process and to the CBRS process. Specific technology opportunities are assigned to other CSS tasks and will transition to the appropriate MARCORSYSCOM PM.

Relationship to Other Programs

The Navy's replenishment program is focused on seabasing operations in weather conditions above Sea State 2. The Navy is beginning to focus this program's work efforts to support the Marine Corps OMFTS warfighting concept. Specific task concentrations include optimizing causeway ferry loadouts, expeditionary moorings, and advanced module connection concepts in Sea State 2 and above conditions. N85 is presently conducting complementary seabase studies and efforts are also under way by MCCDC. The Naval Expeditionary Warfare Engineering IPT is using this AWT Seabasing effort to support Naval Ship and Air platform sensor inputs.

THIS PAGE INTENTIONALLY LEFT BLANK.

SEABASING SUSTAINMENT TECHNOLOGIES



OBJECTIVE:

- TECHNOLOGY ASSESSMENT OF "SEABASING" CONCEPTS TO ID LOGISTICS TECHNOLOGY HURDLES/DEFICIENCIES ACROSS THE SPECTRUM OF WAR W/ EMPHASIS ON OMFTS
- PROVIDE TECHNICAL M&S, WARGAMING, AND ANALYSIS SUPPORT TO OPERATIONAL CONCEPT DEVELOPERS AND FOR EXPERIMENTATION
- SUPPORT NAVAL EXPEDITIONARY WARFARE ENGINEERING IPT AND MAJOR DEFENSE PROGRAM/PLATFORM SPONSORS

CAPABILITIES:

- AMPHIBIOUS LIFT (DESIGN FOR SEA-BASING, VX AND SBX), (R Q1)
- MODELING AND SIMULATION SUPPORT (R Q1)
- REDUCED FOOTPRINT ASHORE (Y Q1)

APPROACH:

- INITIATED NAVAL SEA-BASING TECHNICAL IPT
- SUPPORTING NAVAL EXPEDITIONARY WARFARE IPT
- UPFRONT ANALYSIS: M&S WARGAMING PARTICIPATION
- SHIPBOARD RESPONSIVENESS ANALYSIS
- JOINT INPUT INTO SEABASING CONCEPTS THROUGH SUPPORTED "SEABASING IPT"
- MCCDC IDEF MODELING PARTICIPATION

PERFORMERS:

- NFESC
- NSWC-CARD
- CASDE

SCHEDULE:

TASK	FY96	FY97	FY98	FY99
TRANS/DISTRIBUTION M&S	▲	△		
INTEGRATED PRODUCT TEAM (IPT)		△		△
LOGISTICS 2010 STUDIES & ANALYSIS	▲		△	
WARGAME SUPPORT	▲			△
N85/MCCDC M&SSEABASE C2/TACLOG		△	△	

TRANSITION:

- PM LPD-17, PM MPFE, NAVSEA, MARCORYSCOM PMs
- COMBAT DEVELOPMENT PROCESS (CDP)

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 2. ENGINEERING/SUPPLY/SERVICES TECHNOLOGIES

Problem/Deficiency

Based on the OMFTS concept, the problem with shoreside activities is the rapid establishment of logistics support ashore in conjunction with transportation assets from a seabase. This places a serious constraint on deliberate engineering, resupply technologies, bulk liquid technologies, packaging, and material handling. Equipment and materials must meet the restriction of the transportation assets but still must have the productivity necessary to perform the required engineering/supply/services tasks. Time for logistics support in an OMFTS scenario is particularly short.

Technical Objective/Expected Payoffs

The objective is to develop efficient engineering/supply/services techniques, equipment, and materials that will mitigate the deficiencies stated above in support of OMFTS. Primary objectives are response time, productivity, and transportability. Secondary objectives involve self-deployability, reduced manpower, and operational versatility. The expected payoff is that OMFTS shoreside activities will be rapidly established to provide logistics support in such a way as to be compatible with OMFTS seabase activities including transfer and distribution of classes of supply and CSS.

Technical Background and Approach

The success with which logistics ashore can be rapidly established, in conjunction with OMFTS lift assets, will depend to a large extent on reducing the logistics burden. This burden can consist of time-consuming configurations and installations, repackaging and staging points, overly specialized equipment and facilities, and excessive tare penalties. Reducing this burden is necessary in all areas of CSS with the present focus in this task being on engineering, supply, and services.

Engineering technologies for OMFTS include the following:

a. Construction technologies.

b. Material handling.

c. Bulk Liquids.

d. Throughput Modeling.

e. Fire Fighting

Supply technologies for OMFTS include the following:

a. Packaging.

b. Resupply (expeditionary logistics delivery system).

Services technologies for OMFTS include the following:

a. Field sanitation and hygiene.

b. Washdown technologies.

c. Expeditionary facilities.

<u>Summary of Prior and Current Years' Work</u>

This task was started in FY94. Work in FY95 was as follows:

a. Overall system studies (system architectures for engineering/bulk liquids/ packaging).

b. Bulk liquid transfer technology prototypes.

c. Container technology prototypes.

d. Design concept for an air-transportable container handler.

e. CONOP for OMFTS fuels/engineering/packaging.

Work in FY96 was as follows:

a. Development of a prototype container handler.

b. Development of a meteorological hydrogen generator prototype.

c. Industry/academia survey of packaging materials and concepts.

d. Fuel consumer definition study.

e. Aerial resupply technology report.

Planned Work

The planned work for this project includes the following:

a. Future mission/task analysis study.

b. Alternate environmental control technologies.

c. Field sanitation and hygiene facilities.

d. Reliable alternative power supplies and battery systems.

e. Advanced material handling equipment technologies.

f. Commodity planning tools for six areas of CSS.

g. Bulk liquids technologies.

h. Meteorological hydrogen generator technology.

I. Resupply technologies to include packaging and delivery.

j. Washdown technologies to be used aboard ship, during transit, and ashore.

Transition Plan

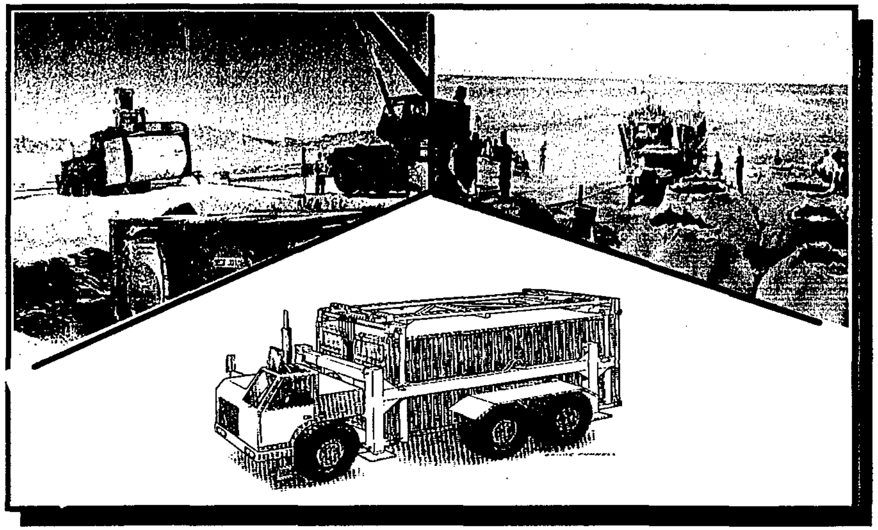
All of the advanced engineering/supplies/services technology concepts will be evaluated in a single ATD 63640M, Advanced Amphibious Logistics (AAL)/CSS. Testing will involve Marine Corps engineering and CSS units. End products will transition to appropriate MARCORSYSCOM PMs.

Relationship to Other Programs

Coordination has been established with the Army material handling program. The Army's sustainment engineering block is focused on increasing CSS during assault follow-on echelon operations. Technical thrusts in this block include equipment, procedures, and rapid construction techniques. The Advanced Amphibious Fuel Systems (AAFS) project is completing development of fly away hose reels and buoyant, low torque swivels for use with thin wall thermoplastic hose. The in-line booster pump is under development. Natick Armament Research, Development, and Engineering Center (ARDEC) is pursuing remote air-drop technologies for various load sizes with particular interest in the Army Advanced Pelletized Air Delivery System (APADS) system. Water production work is on-going with a joint USMC/Army reverse osmosis water purification unit.

THIS PAGE INTENTIONALLY LEFT BLANK.

ENGINEERING/SUPPLY/SERVICES TECHNOLOGIES



OBJECTIVE:

- DEVELOP ADVANCED ENGINEERING AND SUPPLY TECHNOLOGIES TO ENHANCE OPERATIONAL MANEUVER FROM THE SEA AND SEABASING CONCEPTS
- ID AND DEVELOP KEY TECHNOLOGIES FOR EXPEDITIONARY BULK LIQUIDS
- DEVELOP INNOVATIVE SUPPLY STORAGE, HANDLING, AND PACKAGING FOR FUTURE SEABASING SEA/AERIAL RESUPPLY
- ID AND TEST NEW MHE AND EXPEDITIONARY CONTAINER HANDLING CONCEPTS
- CONCEPT EXPLORATION FOR IMPROVED TACTICAL CONTAINER HANDLER MNS

CAPABILITIES:

- AMPHIBIOUS LIFT(DESIGN FOR SEABASING) (R-Q1)
- REDUCTION OF CONSUMABLES (RQ-2)
- DISPOSABLE TECHNOLOGY (REPLACES REPAIR) (RQ-2)
- NATO PROGRAM INTEREST (MOBILIZER)

APPROACH:

- FOCUS ON TOUGH ISSUES: CLASS I, III, V AND FORCE MOVEMENT/THROUGHPUT FROM A SEABASE
- UPFRONT CONCEPT THROUGHPUT M&S TRADEOFF ANALYSIS AND TECHNOLOGY SOLUTION SET ID
- RAPID PROTOTYPE OF ADVANCED ENGINEERING/MHE CONCEPTS FOR OPERATIONAL EXPERIMENTATION
- SUPPORT FMF WORKING GROUPS FOR COMMODITY EXPERT FOCUS
- MAXIMUM EARLY USER INPUT AT FSSG TEST SITES
- SUPPORT "CSS ENTERPRISE" CWL EXPERIMENTATION
- MONITOR D-DAY MOBILE FUEL AND AMMO PROVIDER EFFORTS

PERFORMING ACTIVITIES:

- LAB: NFESC, NATICK, TAACOM, FT LEE
- CONTRACTOR: DREHTAINER TECHNIK

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
MOBILIZER PROTOTYPE	▲	△		
MOBILIZER CONCEPT EVAL		△	△	
ADVANCED FUELS, BULK LIQUIDS CONCEPTS	▲		△	
EXPEDITIONARY HE MHE TECHNOLOGIES		△		△
SEA/AERIAL RESUPPLY CONCEPTS & PACKAGING	▲		△	
WASHDOWN TECHNOLOGIES		△		△

TRANSITION:

- PM CSS/PM ENGINEERS

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 3. LOGISTICS COMMAND AND CONTROL TECHNOLOGIES

Problem/Deficiency

Recent wargames and the S&T Roundtable have identified the lack of logistical C2 tools and decision aids to monitor and plan for supplies and services within required planning cycles. TACLOG/CSSOC functions to support emerging seabase command, control, and logistics concepts require detailed exploration and technology development and integration.

Technical Objective/Expected Payoff

The technical objective of this task is to adapt/develop technologies to improve tactical logistics decision-making and planning. Existing technology will be adapted, as needed, to meet operational requirements. In the absence of appropriate technology, a tech-base approach will be taken to develop the necessary technology. Specifically, the intent is the following:

a. Develop or adapt logistics planning tools at varying echelons from the fire-team to the MEF.

b. Develop or adapt a rapid request tool to support the processing of logistics information from forward areas to a CSSOC.

c. Develop commodity planning tools below the regimental level to facilitate data utilization and lessons learned and provide commodity managers with intelligent systems.

Technical Background And Approach

The key issue for the all of the Logistics C2 subtasks is how to design and implement systems which are interoperable within the USMC MAGTF C4I system as it exists today and how it is envisioned for the future. All of the systems being explored have a requirement to access and use information which exists within the USMC MAGTF C4I system or to provide a gateway function which allows the flow of information from other systems, via the Global Command and Control System (GCCS), into the USMC MAGTF C4I system. However, each Logistics C2 system must also provide the full logistics functionality and show some interoperability with existing Logistics Automated Information Systems (LOGAIS), not presently part of the C4I system.

Summary of Prior And Current Years' Work

These efforts are new starts in FY97.

Planned Work

The CSSOC Technologies sub-task is a new start for FY97. Commercial, Navy, and Army systems will be investigated for application of technologies for use in the CSSOC. In particular, planning and scheduling tools will be sought to be used in logistics planning and tasking. A task breakdown methodology will be developed for an automatic asset-to-task mapping capability.

The rapid request CSSC2 sub-task is a new start for FY97. Requirements analyses, including communications and CSS requirements, will be performed to design a user interface to facilitate effective rapid replenishment for small mobile, independent fire teams. A rapid prototype tool showing these capabilities will be designed, developed, and demonstrated.

The Logistics Anchor Desk sub-task is also a new sub-task for FY97, targeted at providing a gateway between the MAGTF II LOGAIS tools and data bases, the Combat Operations Center-Interim (COC(I)), and the GCCS. A physical architecture between these systems will be laid out once GCCS protocols and access requirements are determined. The goal of this effort is to provide a means for intelligent information extraction and decision making tools for all levels of command echelon.

The Commodity Planning Tools sub-task is also a new FY97 start, targeting automated and intelligent data manipulation and control at the commodity manager level of the CSSD and allowing full advantage to be taken of lessons learned and resident USMC knowledge. This system of planning tools will also interface with the CSSD C2 system developed under the previous sub-tasks.

Transition Plan

Technologies developed in this task will transition to the MARCORSYSCOM PM for Engineering Systems and the PE 63640 ATD.

The CSSOC technologies will transition to MCTSSA for evaluation of usefulness in a CSSOC environment. They will also be installed in the Force Service Support Group (FSSG) Crisis Action Center as a test site for user feedback and eventually transitioned to the Director, C4I and PM Software, MCTSSA.

The rapid request CSSC2 work will be transitioned to the GCCS program to provide the capability for small, independently-tasked, mobile fire teams to access logistics anchor desk information.

The Logistics Anchor Desk effort will transition to be part of the GCCS program to provide the gateway between CINC-level information and lower echelon CSS units.

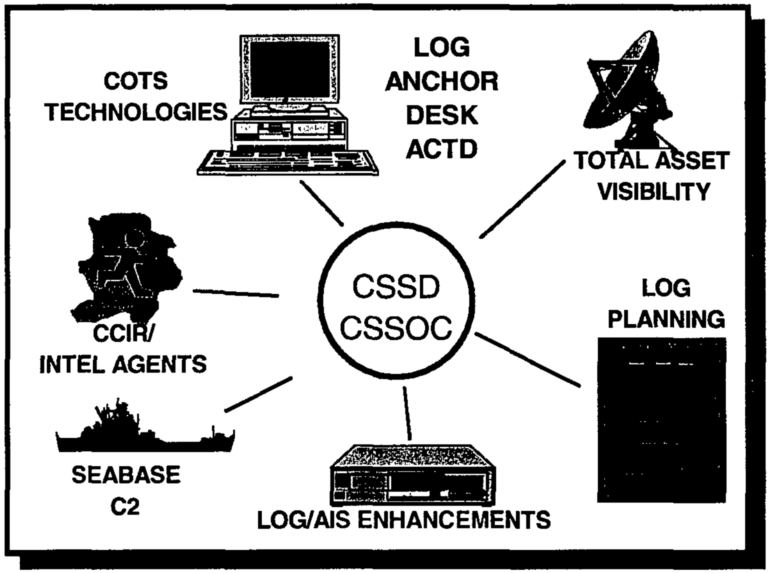
The Commodity Planning Tools effort will transition to the C4I Logistics PM.

Relationship to Other Programs

The use of collaborative and decision management tools is occurring in academia, the business community, and in the other Services. Lessons learned from these areas will be integrated into this project. In addition, coordination with the Defense Modeling and Simulation Office (DMSO) COMPASS project and the DARPA ATD for Portable C2 for the Commander, Joint Task Force will be leveraged for their results in tactical planning support tools. Finally, while the immediate focus will be on improving the decision making process at all levels of C2, the long-term goal is to integrate the iterative results into the Joint C4I Technologies ATD, specifically that portion dealing directly with the ICOC.

THIS PAGE INTENTIONALLY LEFT BLANK.

LOGISTICS COMMAND AND CONTROL TECHNOLOGIES



OBJECTIVE:

- ID AND DEVELOP LOG C2 TECHNOLOGY IMPROVEMENTS AND NEW CONCEPTS TO SUPPORT IMPROVED LOGISTICS OPERATIONS AND PLANNING FOR OPERATIONAL MANEUVER FROM A "SEABASE"
- PROVIDE A RAPID TECHNOLOGY INSERTION EFFORT FOR JOINT LOGISTICS ATD AND ACTD EFFORTS IN SUPPORT OF "VISION 2010" FOCUSED LOGISTICS.

CAPABILITIES:

- AMPHIBIOUS LIFT (DESIGN FOR SEA-BASING) (R Q1)
- REDUCTION OF CONSUMABLES (R Q2)
- MERGED M&S AND C2 SYSTEMS (Y Q1)
- LOG DEFENSE TECHNOLOGY OBJECTIVES (DTOs)
- MOU WITH JOINT LOGISTICS ACTD (LOG ANCHOR DESK)

APPROACH:

- EARLY USER EVAL AND RAPID PROTOTYPING STRATEGY FOR SOFTWARE DEVELOPMENT WITH CSS ENTERPRISE
- RAPID EVALUATION OF GOTS/COTS FOR TECH INSERTION
- MAXIMIZE JOINT COOPERATIVE DEVELOPMENTS WITH DARPA/OTHER SERVICES
- SUPPORT COOPERATIVE DEVELOPMENT LINKS BETWEEN MCTSSA AND IRMD, ALBANY
- LEAN FORWARD WITH CWL/CSS ENTERPRISE EXPERIMENTATION IN SUPPORT OF THE CDP

PERFORMING ACTIVITES:

- NRaD, NFESC, MCTSSA

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
HW AWE SUPPORT	▲	△ △		
RAPID REQUEST SW	▲		△	
SEABASE/CSSOC C2 PROTOTYPE		△		△
COMMODITY PLANNING TOOLS		△		△
LOG ANCHOR DESK		△	△	

TRANSITION:

- DIR C4I AND MCTSSA, PM SOFTWARE, MCLB ALBANY

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 4. TRANSPORTATION, MAINTENANCE, AND CORROSION CONTROL TECHNOLOGIES

Problem/Deficiency

The Department of the Navy's recent white paper "Forward...From The Sea" recognizes the changes in the strategic landscape and marks an evolutionary shift away from Cold War thinking. Integral to this broad document is the Marine Corps' concept of OMFTS. The key to OMFTS is the mobility of naval forces at sea, the rapid buildup and maneuver of combat power inland, and the successful sustainment of those forces until the accomplishment of critical objectives. It is during this latter logistical part of the OMFTS operation that the seabasing concept presents the most challenges. Conducting multiple functions such as command and coordination, naval surface fire support, and logistical operations from a seabase requires situation awareness, precision weaponry, and sustainment assets with increased mobility, range, lift capacity, and improved RAM-D, all at an affordable price.

Technical Objectives/Expected Payoffs

The technological thrust of this task is to enhance and improve the sustainment assets that conduct logistics operations in support of future missions such as joint littoral operations, amphibious assaults, political operations, humanitarian, and OMFTS. Alternative concepts, platforms, and configurations will be developed and evaluated using traditional T&E methods as well as advanced M&S tools to assess mobility characteristics, system performance, and concept feasibility. This task is also designed to develop technology to minimize corrosion related degradation of USMC systems that are in use or intended for use in the future. Emphasis will be placed on RDT&E of new materials, methods, and components designed for CPAC. The expected payoffs will be the attainment of new components and subsystems required for mid-term and future logistics vehicles and the maturation of new system concepts to support the successful sustainment of OMFTS or other operations. With improved corrosion reduction practices, the life cycle cost of any given vehicle can be reduced, as well as the elimination of certain environmental concerns.

Technical Background and Approach

Surface sustainment assets are historically slow swimming ships/vehicles with limited payload and range. Other drawbacks include non-amphibious operations, poor amphibious ship interface, large footprint, non-organic handling equipment, low budgetary priority, and lack of stealth technology. Also, current USMC policies for corrosion control are deficient in that an extensive amount of effort is required in the field by the user to maintain a corrosion free operating vehicle. Current practice for coating vehicles to reduce rust or component degradation is a financial burden to the user due to the environmental concerns voiced by the civilian community surrounding the military installation.

This effort involves the development and evaluation of advanced system platform concepts that accomplish logistic roles with all the performance characteristics required of sustainment assets operating in advanced OMFTS scenarios. M&S based design tools will be employed to evaluate alternative chassis designs, total vehicle/platform system architecture, land and water mobility performance, and propulsion system efficiencies. The most promising concepts shall be matured and analyzed for high technical risk areas, cost drivers, and other system level issues. Individual projects will be initiated to address the most important issues to refine the concept and find feasible solutions. In addition, this task will continue to research, develop, and evaluate existing, as well as new, technologies that fulfill known deficiencies in either the concepts generated or existing systems. These include high horsepower density engines/power sources, high efficiency drive trains, and lightweight corrosion tolerant components. This can be accomplished through the development and evaluation of new materials, methods, and components in conjunction with new maintenance procedures.

Summary of Prior and Current Years' Work

During FY96, the development of advanced vehicle concepts for the ELT was initiated. As a result of the BAA solicitation, a total of four (4) concepts are being developed by four (4) different contractors who are addressing the spectrum of known operational functions and missions. These concepts are based on operational requirements derived through examination of current OMFTS and related doctrine. Through M&S assessment tools, these concepts are being evaluated to provide maximum payoff in operational utility and effectiveness. These concepts will be further examined for operational suitability. Potential future mission scenarios are being developed and broken down into individual functional capabilities and requirements.

Regarding corrosion Research and Development (R&D), an official report was disseminated which discussed the status of technology development and evaluation efforts, vehicle surveys, and design analyses. The marine atmosphere exposure test matrix was expanded to include additional technologies and treatments such as inorganic coatings for sheet metals and exhaust systems and new alternative materials for various vehicle components. Concurrently, accelerated test procedures were initiated to determine applicability to predicting corrosion performance in typical USMC operating environments. The items currently under investigation in the accelerated test program are simultaneously part of the marine atmosphere test matrix in order to provide data for comparison and validation. Field tests were initiated for several additional items also under evaluation in the marine atmosphere test matrix. This will allow for the acquisition of corrosion data under dynamic conditions such as vibration and engine cycling. Plans for field testing heat resistant coatings to combat high temperature corrosion problems have been initiated. M&S tools appropriate for predicting corrosion in a marine environment were surveyed and determined. These tools were determined to be inadequate for the prediction of complex corrosion phenomenon typical experienced by USMC vehicles. A review of corrosion specifications for the Lightweight 155 Howitzer program was conducted.

Planned Work

FY97 efforts will involve continued detailing of ELT vehicle concepts, identification of technology development efforts, and acquiring additional assessment tools to evaluate system and subsystem level performance. All concepts of future sustainment systems will be developed to produce future desired logistical capabilities. Such systems or platforms will require the range, speed, and payload to deploy from seabased distances up to 200 nautical miles, seamlessly transit surface and beach zones to attack objective areas as far as 60 miles inland, and avoid/ counter the numerous obstacles/threats that lay in wait. These concepts will provide a highly mobile surface platform for transporting combat support and CSS equipment to inland forces. Current deficiencies in payload, range, low and high speed maneuverability, all weather capability, ride quality, and footprint will need to be improved as the concept is developed. All forms of system configurations will be investigated including self contained vehicles, delivery platforms, and seaworthy adaptations of advanced land systems. Planned efforts include preparing for the transition to the FY98 ATD and fostering a joint program with Navy and Army counterparts.

Corrosion efforts initiated in FY96 will continue with emphasis placed upon the RDT&E of materials and processes to minimize or reduce corrosion of USMC systems. In the first focus area of problem identification, all field tests will be monitored regularly in order to evaluate the success of the treatment approaches in an actual operational environment. Maintenance and cost data will continue to be gathered in order to provide a basis for evaluating life cycle impacts of future design improvements or technology applications. For FY97, the second focus area of technology transfer and design analysis will continue to emphasize liaison with both Army and private industry and other government organizations. Coordination in this area will include USMC participation in an Army effort to evaluate new rubber-based coatings through inclusion into ongoing test matrices. Design inputs and material recommendations will continue to be evaluated for the future rebuild efforts of the 5-ton Truck, HMMWV, and Logistics Vehicle System (LVS). The final focus area of corrosion test evaluations will receive the greatest emphasis. The marine atmospheric corrosion tests initiated in FY96 will be continued as part of the investigation and testing of new technology, including those developed under existing SBIR programs, in the third and primary focus area. Further field tests will be initiated to evaluate additional technologies, potentially including those developed under SBIR programs. In addition, the application of accelerated corrosion testing techniques will be continued. Tests used to evaluate the performance of corrosion resistant materials and coatings shall be tested for use in exhaust systems will be monitored. Finally, evaluations of corrosion inhibitors will be initiated.

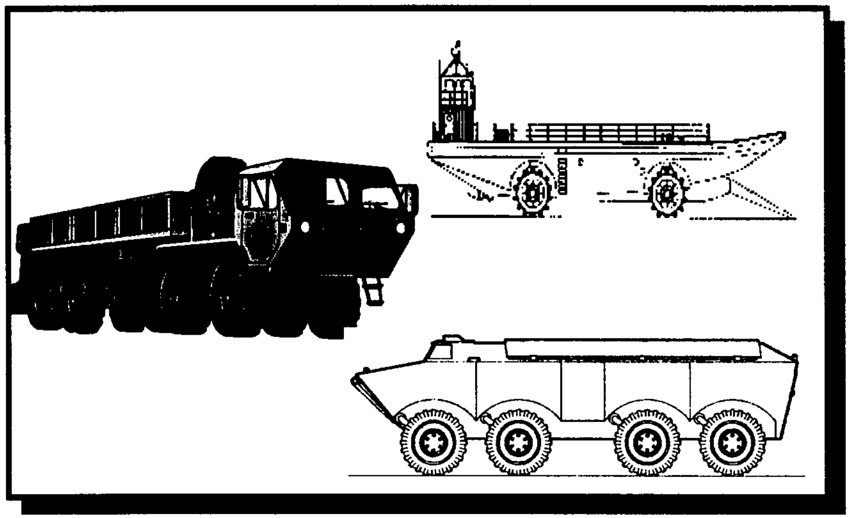
Transition Plan

As promising technologies mature within this task, they will transition via the program elements to ATDs or individual PM systems. As an example, the US Army's TARDEC and the MARCORSYSCOM PM for CSS have sponsored and funded two separate initiatives within the Lightweight Cooling Component Development project.

Relationship to Other Programs

US Navy is involved in this effort helping to develop vehicle capabilities through the new and emerging seabasing concept, follow-on amphibious ship programs, and current CSS program. Their involvement at this early stage will provide a smooth transition to anticipated future joint ATD efforts. The Navy also has several on-going corrosion control programs (i.e., topside connector study and heat resistant treatments) which are being monitored for application to this program. In addition, three Phase I SBIR efforts were initiated in FY96 which focus on innovative solutions to high temperature corrosion problems. The Phase II SBIR initiated in FY95, entitled "Diamond-Like Nanocomposite (DLN) Protective Coatings for the Exterior Surface of Weapon Components", is continuing. This project is focusing on the application of a DLN family of coatings for corrosion and erosion protection as well as thermal management and strengthening to USMC substrates and components of interest. FY97 plans include the incorporation of DLN-treated samples into ongoing accelerated or marine atmosphere exposure test matrices.

TRANSPORTATION AND MAINTENANCE TECHNOLOGIES



OBJECTIVE:

- SUPPORT OMFTS LOGISTICS CONCEPT WITH SEAMLESS MANEUVER, THROUGH ASSESSMENT, DEVELOPMENT AND TECHNOLOGY INSERTION OF INNOVATIVE TRANSPORTATION SYSTEMS

CAPABILITIES:

- ADDRESS S&T ROUNDTABLE NEED FOR:
  - IMPROVED AMPHIBIOUS LIFT/DESIGN FOR SEABASE (R-Q1)
  - REDUCED FOOTPRINT ASHORE (Y-Q1)
  - MODULAR COMBAT SUPPORT TRANSPORT (Y-Q1)
  - INCREASED PLATFORM EFFICIENCY (G-Q2)
  - INCREASED SPEED/RANGE (Y-Q2)
  - ALL TERRAIN/WEATHER/ENVIRONMENT (G-Q1)

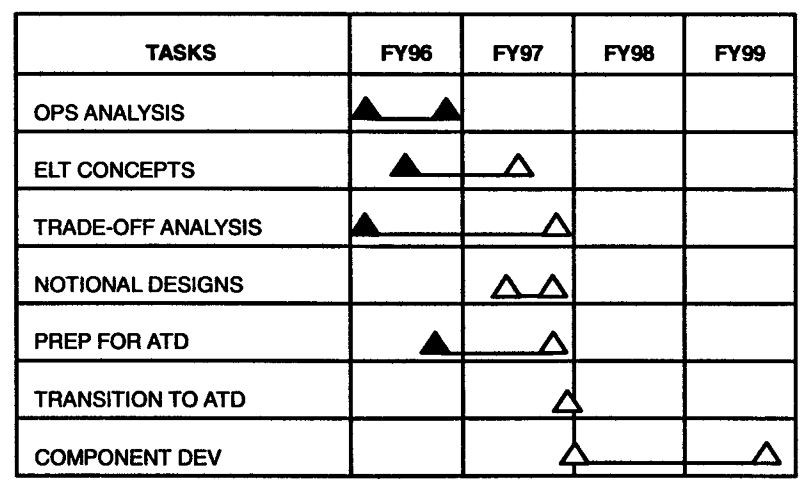
APPROACH:

- PERFORM OPERATIONAL AND TECHNICAL ASSESSMENT TO ADDRESS FUTURE LOGISTICS PLATFORMS NECESSARY TO CONDUCT USMC MISSION
- DEVELOP PLATFORM CONCEPTS FOR IMPROVED LOGISTICS OPERATIONS
- CONDUCT MODELING, SIMULATION AND TRADE-STUDIES TO ASSESS TECHNICAL PARAMETERS AND PERFORMANCE LEVELS
- IDENTIFY AND DEVELOP TECHNOLOGIES TO ENABLE SYSTEM CONCEPTS
- PERFORM DETAILED DESIGN, ANALYSIS AND EVALUATION
- PREPARE FOR AND TRANSITION TO ATD FOR SYSTEM REFINEMENT AND DEVELOPMENT
- INITIATE POTENTIAL JOINT EFFORTS WITH ARMY/NAVY

PERFORMERS:

- NSWC-CARDEROCK
- AAI, BAND-LAVIS, MARITIME APPLIED PHYSICS CORP, CASDE CORP

SCHEDULE:

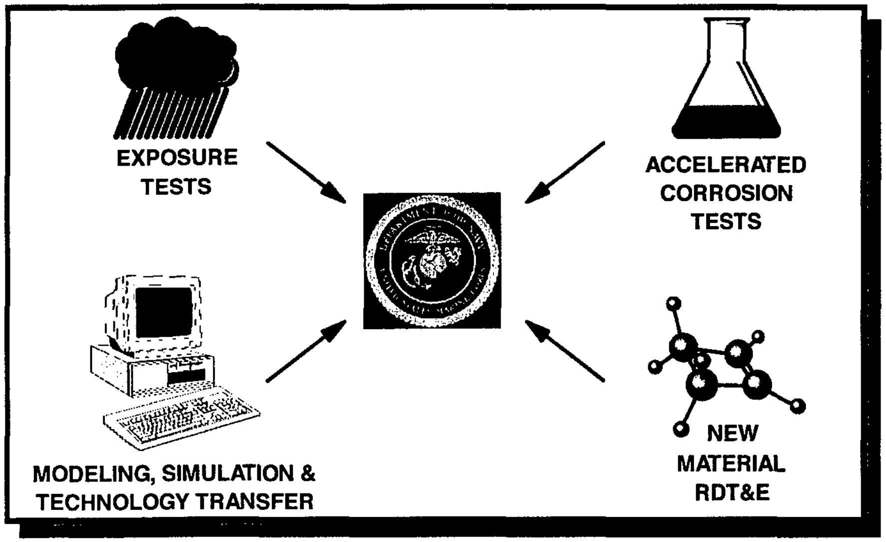


TRANSITION:

- PM - SSC

THIS PAGE INTENTIONALLY LEFT BLANK.

CORROSION CONTROL



APPROACH:

- COORDINATED EFFORT WITH CPAC WORKING GROUP FOR TRANSITIONS TO FMF
- RDT&E NEW CORROSION CONTROL TECHNOLOGIES
- UTILIZE SBIR PROGRAM FOR NEW CORROSION RESISTANT SOLUTIONS: DIAMOND LIKE NANO-COMPROITES, HIGH TEMPERATURE TREATMENT AND COATINGS
- ADAPT AND VALIDATE COMMERCIAL ACCELERATED TESTING PRACTICES FOR MILITARY ENVIRONMENTS AND SCENARIOS
- ESTABLISH M&S DATABASE TO INCLUDE COST-BENEFIT
- JOINT USMC-ARMY RUBBER BASED COATING

PERFORMERS:

- NSWC-CARDEROCK, CASDE,
  LaQue TEST FACILITIES, ART TECHNOLOGIES

OBJECTIVE:

- ASSESSMENT, DEVELOPMENT, AND TECHNOLOGY INSERTION OF NEW OR COTS/NDI COMPONENTS TO FMF ASSETS FOR REDUCTION OF MAINTENANCE OR COST BURDEN DUE TO CORROSION RELATED FAILURES

CAPABILITIES:

- ADDRESS S&T ROUNDTABLE NEED FOR:
  - REDUCTION OF CONSUMABLES (R-Q2)
  - DISPOSABLE TECHNOLOGY (R-Q2)

SCHEDULE:

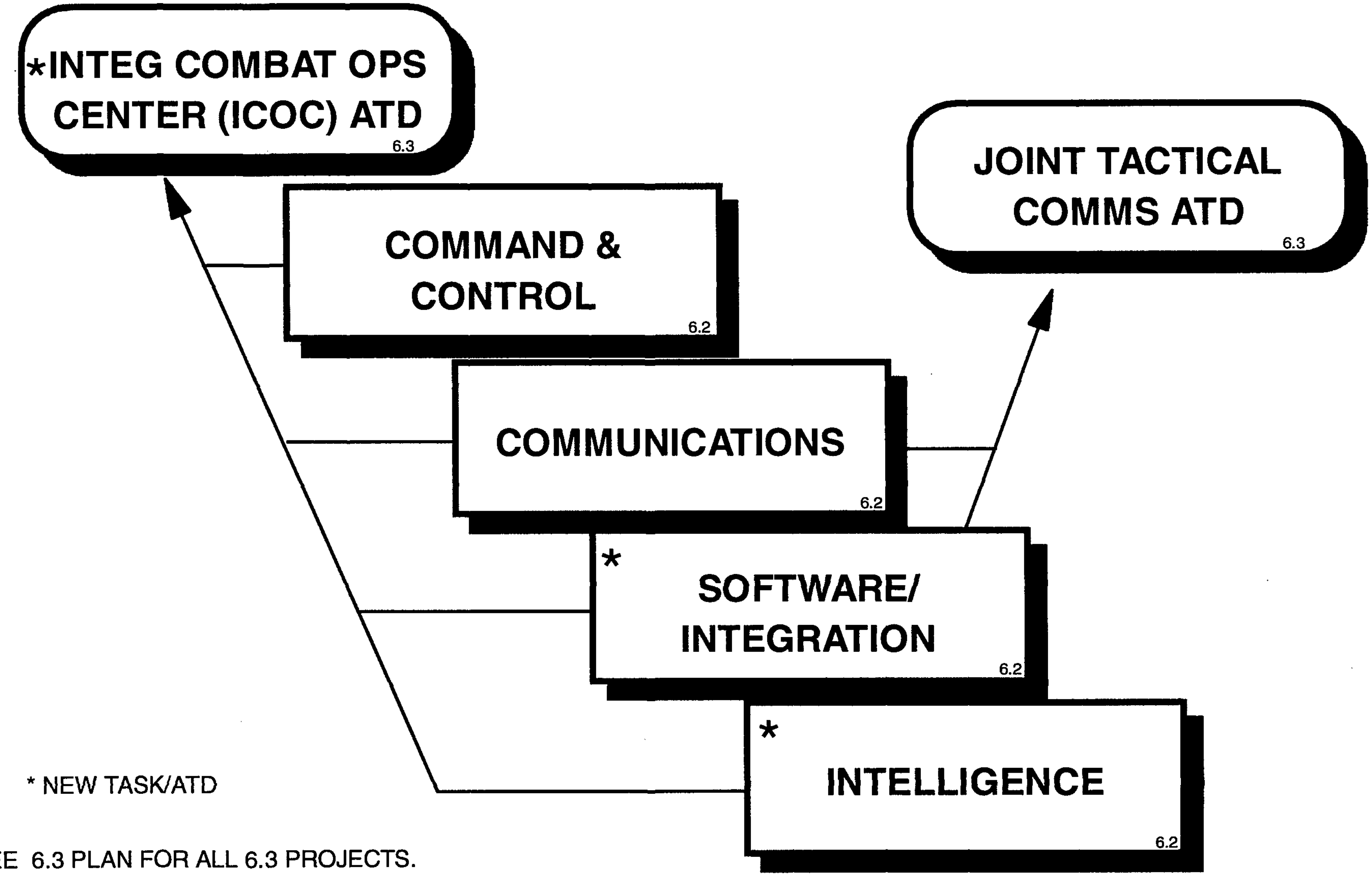
TASKS	FY96	FY97	FY98	FY99
M&S DATABASE	▲		△	
HIGH TEMP SBIR	▲	△		
DLN SBIR	▲	△		
JOINT ARMY COATING	▲	△		
ATM TESTING	▲			△
ACCL TESTING	▲		△	
FLCV ASSESSMENT	▲			

TRANSITION:

- ALL MARCORSYSCOM PMs

THIS PAGE INTENTIONALLY LEFT BLANK.

COMMAND AND CONTROL IMPERATIVE



* NEW TASK/ATD

NOTE: SEE 6.3 PLAN FOR ALL 6.3 PROJECTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

Imperative Title: COMMAND AND CONTROL

THIS PAGE INTENTIONALLY LEFT BLANK.

COMMAND AND CONTROL IMPERATIVE

PROJECT OBJECTIVES AND TECHNICAL THRUSTS

MAGTF C4I is the Marine Corp's overarching concept for integrating communications and tactical data systems on the modern battlefield. The objective of the C2 Technology Project is to demonstrate the feasibility of converting emerging electronics and information management and communications technologies developed by the other Services, government agencies, academia, and the private sector into demonstration systems which support USMC amphibious operations. C2 capabilities will be investigated which will provide tools to automate the decision making process for commanders at all echelons. These decision aids will permit commanders to quickly react to their environment through the judicious employment of forces. Communications capabilities are being pursued which support the unique USMC requirements for long-range, high bandwidth connectivity during the assault phase of an amphibious operation. Computer software solutions to support the need to operate in combined operations and to automate the planning process are being explored. Intelligence support capabilities, in the form of signals collection and exploitation and video capture and processing, are being evaluated for potential exploratory work. C2 Warfare (C2W) support will provide capabilities to counter the Information Warfare (IW) threat.

STRUCTURE AND TASK IDENTIFICATION INCLUDING OUTYEAR NEW STARTS

C2

Automatic searches and alerts using information systems, databases, and message traffic are being developed to support the Commander's access to his CCIRs.

Communications

Using investigation results from last year, development and concept demonstrations will be conducted employing communications technologies which are capable of high-quality, high bandwidth digital transmissions. The goal is to develop and demonstrate tech-base solutions to OTH, ship-to-shore communications with a 10 Megahertz (MHZ) bandwidth and up to 200-mile ranges.

Software/Integration

Formerly called the Computers subtask, beginning in FY97 the task area has been renamed Software/Integration. This task provides support to the MCTSSA, the Marine Corp's primary software support activity for all fielded tactical systems. Prototype systems developed under this C2 project will ultimately transition to MCTSSA for integration into operational systems.

Intelligence

Intelligent systems in a handheld device are being investigated to support Radio Reconnaissance Teams (RRT) by detecting and locating 20 to 1000 MHZ RF energy within 5 km from the team. Initial investigations and potential concepts will be made into the use of RF devices and intelligent software to combat adversary intrusion into US forces C2 information systems. Both hard and soft kill options will be considered.

COMMAND AND CONTROL IMPERATIVE ($K)

TASK NO	PERFORMER	FY96 CURRENT FY	FY97 EXECUTION FY	FY98 BUDGET FY	FY99 BY+1 FY	FY00 BY+2 FY
1	NCCOSC	435	250	250	200	425
	CONTRACTOR	300	212	378	290	300
2	NCCOSC	400	595	300	300	200
	CECOM	0	100	400	400	405
	CONTRACTOR	0	0	100	125	0
3	NCCOSC	1115	198	250	200	200
	MCCDC	276	300	300	350	450
	CONTRACTOR	377	172	150	150	495
4	NCCOSC	700	200	375	375	325
	CONTRACTOR	0	125	400	400	500
PROJECT TOTALS		3,603	2,152	2,903	2,790	3,300

TASK NO.	TITLE
1	COMMAND AND CONTROL
2	COMMUNICATIONS
3	SOFTWARE/INTEGRATION
4	INTELLIGENCE

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMMAND AND CONTROL

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. COMMAND AND CONTROL														
A. CCIR Processing														
(1) Requirements Analysis	S	C												
(2) Concept of Operations		S	C											
(3) Software Design	S			C										
(4) Rapid Prototype Development		S		C										
(5) Rapid Prototype Demonstration				DR										
(6) Prototype Development					S		C							
(7) Prototype Demonstrations						D		DRT						

MILESTONE SYMBOL LEGEND

S = Start	--- Indicates Slippage
C = Complete	Symbol without underline indicates PLANNED
D = Major Demo	Underlined symbol indicates ACTUAL
H = Hardware Available	Notes are provided for necessary clarification
T = Transition	
R = Report	
O = Other	

NOTES:

1. System capabilities (H/W & S/W) may transition to the appropriate PM for consideration as an evolutionary upgrade to fielded or developing MAGTF C4I systems (e.g., TCO, MCSSC2, etc.)
2. System capabilities may be appropriate for consideration as a capability within the GCCS COE (S/W), and possibly as a USMC MAGTF C4I system peripheral (H/W).

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMMAND AND CONTROL (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. COMMUNICATIONS														
A. Over the Horizon (OTH) Communications														
(1) Phase II Contracts (On Hold)	<u>S</u>													
(2) Expeditionary Links & Networks														
a. CECOM/BADD Comms					S			H						
b. OTH Network Concept				<u>S</u>			R				D	RC		
c. Relay Demonstrations				<u>S</u>		D	R							

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Demonstration results have been furnished to the PM for communications for his considerations to initiate an acquisition program. Program results will also be furnished to the applicable offices of the US Army CECOM (RDEC), ARPA, and NSA.

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMMAND AND CONTROL (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. SOFTWARE/INTEGRATION														
A. Amphibious Assault Planner														
1. System Enhancements	S	D												
2. User Manual			S	C										
3. Support Transition		S	D	CT										
B. Korean-English Language Technology														
1. System Technical Description			CR											
2. Forward Tactical Prototype	S			CRD										
3. Transition Speech Recognition		S	D	CT										
4. Operations Other Than War			S	D										
C. MCTSSA Support														
1. Support for New ATD Starts	S			R	S			R						
2. Participate in Working Groups	S			R	S			R						
3. Define Integration & Integration Strategies	S			R	S			R						

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. System capabilities will be made available to the PM for C2 for his consideration in fulfilling portions of applicable MNS.
2. Exact transition plans are unclear at this time. Potential exists for this system to be transitioned as a subset of another system, or for individual components to be integrated into other systems.

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: COMMAND AND CONTROL (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 4. INTELLIGENCE														
A. Radio Recon. Technology														
(1) Enhanced Requirements I.D.		S	CR											
(2) Technology Survey			S	CR										
(3) Solution Development					S		C	D R						
B. Information Warfare														
(1) Requirements Identification					S	CR								
(2) Technology Survey						S	CR							
(3) Rapid Prototype of Technology Selected							S	DR						
(4) Solution Development									S			CDR		

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 1. COMMAND AND CONTROL

Problem/Deficiency

FMF Manual (FMFM)-3, C2, discusses the movement of C2 information from where it exists to where the information is needed, which is with the operational commander. Requirements for rapid transfer of information and distributed C2 are also described.

The Marine Corps is currently unable to effectively support the command decision maker due to the inability to access, transfer, and assemble the available information in an expeditious and organized fashion. The changing nature of operations in support of expeditionary warfare and OMFTS places intense demands on the design of C4I architectures that must provide tools for the commander's use to effect C2 of his forces and at the same time be interoperable with other Service components of a JTF, as well as higher commands.

The thrust of this task is to provide automated support to the decision maker in information management, dissemination, and C2 planning through the development of specific tools and architectures to be used in joint warfighting environments. One of the problems and deficiencies specifically addressed within this task is the lack of a simple way for commanders to access and coordinate mission-specific knowledge unless it is co-located within the planning cell.

Technical Objectives/Expected Payoffs

The technical objective of this task is to adapt/develop technologies to improve tactical decision-making and planning. Existing technology will be adapted as needed to meet operational requirements. In the absence of appropriate technology, a tech-base approach will be taken to develop the necessary technology. Specifically, the intent is to develop capability to filter needed information from information data bases and both formatted and unformatted message traffic.

Technical Background and Approach

The key issue for all of the subtasks is how to design and implement systems which are interoperable within the USMC MAGTF C4I system as it exists today and how it is envisioned for the future. All of the systems being explored have a requirement to access and use information which exists within the USMC MAGTF C4I system, or to provide a gateway function which allows the flow of information from other systems, via the GCCS, into the USMC MAGTF C4I system.

Summary of Prior and Current Years' Work

The COA Simulator (COASIM) subtask was initiated in June of 1994 and transitioned to MCTSSA in FY96. This prototype was an initial attempt to automate the manual decision making process used at the battalion level by commanders to determine COAs based on situation assessment.

The CCIR subtask is another decision aid to assist the commander in selecting the appropriate COA to execute effective C2. Commercially available text search technology and innovative graphical user techniques are being used to automate the processing of CCIRs.

The Scaleable Tactical Picture subtask was terminated during the year based on a decision that a similar functionality already exists elsewhere in the Marine Corps organization.

Planned Work

The prototyping effort for easy entry of housekeeping, trigger, and alarm type CCIRs into a GCCS workstation will continue by adding more CCIRs to the implementation list. In addition, the capability to filter unformatted message traffic for CCIRs will be developed. Continual improvement in the graphical user interface will be made.

Transition Plan

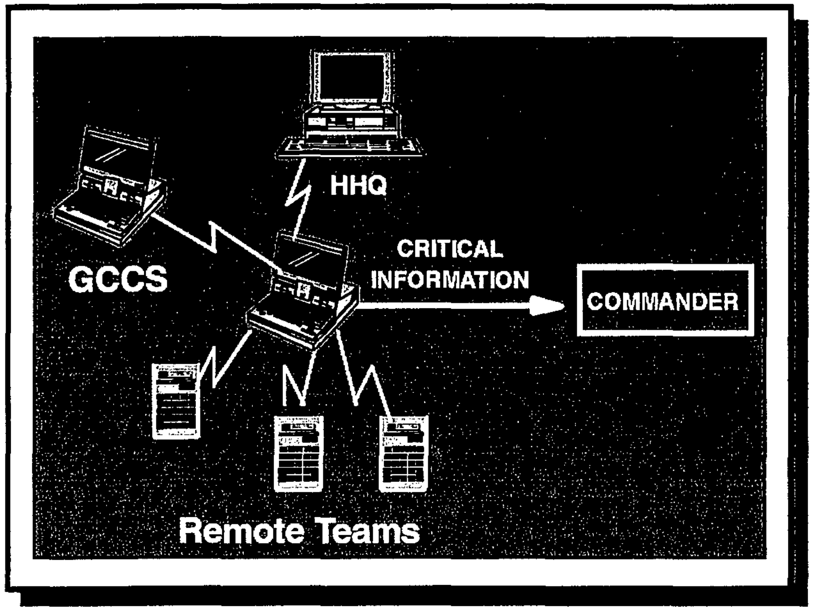
The CCIR effort will transition to the Joint C4I Technology ATD or the ICOC ATD. It will be transitioned to MCTSSA for user evaluation and be part of the Marine Corps software baseline.

Relationship to Other Programs

The contractor for the CCIR task also did CCIR processing for the Army. Marine Corps CCIR functionality will be demonstrated in February 97 during the Hunter Warrior exercise for Sea Dragon to be conducted by the CWL.

The use of collaborative and decision management tool, is occurring in academia, the business community, and in the other services. Lessons learned from these areas will be integrated into this project. In addition, coordination with the DMSO Common Operational Modeling Planning and Simulation System (COMPASS) project and the DARPA ATD for Portable C2 for the Commander, Joint Task Force will be leveraged for their results in tactical planning support tools. Finally, while the immediate focus will be on improving the decision making process at all levels of C2, the long-term goal is to integrate the iterative results into the Joint C4I Technologies ATD, specifically that portion dealing directly with the ICOC.

COMMAND AND CONTROL



OBJECTIVE:

- DEMONSTRATE BATTLEFIELD VISUALIZATION SOFTWARE THAT PROVIDES THE COMMANDER "NEAR" REAL TIME UPDATE OF CRITICAL INFORMATION, IN A GRAPHIC FASHION THAT FACILITATES SITUATIONAL AWARENESS AND DECISION MAKING

CAPABILITIES:

- REAL TIME HIGH DATA RATE INTEL ANALYSIS TAILORED TO USER (R Q2).
- INTELLIGENCE PROCESSING / ANALYSIS TRANSPARENT TO USER (Y Q2).
- CONDUCT MISSION PLANNING IN DISTRIBUTED ENVIRONMENT (G Q2).

APPROACH:

- DEVELOP MESSAGE FILTERING AND INTELLIGENT AGENT SEARCH SOFTWARE
- EVALUATE UTILITY TO A COMMANDER IN PROVIDING SITUATIONAL AWARENESS ON INFORMATION HE REQUIRES FOR PLAN DEVELOPMENT AND FOR EXECUTION MONITORING
- COORDINATE WITH DARPA'S MESSAGE HANDLING SYSTEM PROGRAMS FOR NATURAL LANGUAGE PROCESSING
- DEMONSTRATE CAPABILITY DURING HUNTER WARRIOR

PERFORMERS:

- LAB: NRaD
- CONTRACTOR: CHI SYSTEMS

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
DESIGN CONCEPT DEFINITION	▲ ▲			
SOFTWARE DESIGN	▲—▲			
RAPID PROTOTYPE	▲—	△		
DEMONSTRATION		△		
PROTOTYPE DEVELOPMENT		△—△		
CONFIG CONTROL BOARD			△	

TRANSITION:

- DIR C4I
- MCTSSA (PM SOFTWARE)

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 2. COMMUNICATIONS

Problem/Deficiency

The Navy-Marine Corps team has adopted the operational concept of applying the principles of maneuver warfare to a maritime campaign. This concept, known as OMFTS, has again heightened the requirement for a robust, long-haul, communications capability to support the dynamic environment envisioned by OMFTS. As a forward deployed, expeditionary force, the Corps' combat forces require the ability to operate (communicate) in a manner which enhances their survivability. Survivability in this sense refers to the ability to operate undetected and with the maximum amount of mobility. The Marine Corps also has a stated requirement for a cellular communications capability to support deployed forces. These communications requirements emphasize that future USMC communication systems must provide for joint interoperability between the Services, as well as being able to access the myriad communications systems of other government agencies and commercial vendors.

Technical Objectives/Expected Payoffs

A goal of this task is to develop communications prototypes that will permit over-the-horizon communications (OTH Comm) of up to 200 miles under the conditions of maneuver warfare. Such a system must demonstrate the technical capability of mobile information transfer at a rate of 10 megabytes-per-second (MBps), and not be tied to a satellite constellation. With such capabilities available to a Naval Expeditionary Force, the Commander's ability to execute C2 functions and conduct C2W is significantly enhanced.

Technical Background and Approach

The OTH Comm subtask will seek to develop a high data rate (10 MBps) and reliable ship-to-shore communications system with a range of up to 200 miles. Such a capability will not be reliant upon satellites and will exhibit, as much as possible, Low Probability of Intercept/ Detection (LPI/LPD) signal characteristics. The approach for this task will be to exploit technologies developed by private industry, the DARPA Battlefield Awareness and Data Distribution (BADD) program, and the USMC Ultra Wideband (UWB) program and make only those modifications necessary to enable them to meet the Corps' requirement.

CWL scenarios challenge tactical communications. With current satellite systems, both mobility and capacity of communications remain very limited. If mobility is important, then the practical capacity for maneuver forces is not much more than a voice channel. If capacity is critical, then links are constrained to steerable, large aperture antennas usually confined to fixed locations with long set-up times. Satellite channels themselves are available only in limited numbers and capacity.

Terrestrial communications with today's commercial or military radios are range limited. In most likely scenarios terrain and vegetation obstructions limit reliable links to less than a few miles. The southeast Asia experience, capturing hilltops for purposes of establishing reliable longer range communications remains an undesirable option. Terrestrial networking, to be reliable, assumes a high density of nodes each capable of automated retransmission. Airborne relays remain as the only "in between" option for simultaneously providing longer range, higher capacity, higher quality, reliable communications.

Summary of Prior and Current Years' Work

The Phase II contract was put on hold when ONR was not able to provide the shared funding according to plan. The continuing effort for FY97 was modified to focus on technology tradeoffs between trunkline and networked operations for OTH relays. In addition, a number of different options were evaluated for demonstration in support of the CWL for Force XXI. These concepts are listed as follows: Pathfinder (NASA); Project Sounder; Tactical Data Relay Support System Waveform Relay (NASA); Secure Packet Radio/Wireless Net Access (Hazeltine); Airborne ONR Radar Range Balloon; and Mountaintop surrogate.

Planned Work

The planned work for FY97 consists of three subtasks. The first requires Communication - Electronics Command (CECOM) to participate in and extract communications from the DARPA BADD program appropriate to USMC missions. The focus will be on the message connection between Special Purpose MAGTF (SPMAGTF) Tactical Operations Center (TOC) and other USMC force elements.

The second subtask is to continue the technology tradeoffs between trunkline and networked applications for OTH relays. The Near Term Digital Radio (NTDR) project of ITT and the Secure Packet Radio/Wireless Net Access by Hazeltine will be designed into extended Wide Area Radio Networks. Detailed analysis of the CWL OTH Comm demonstration task will be completed. Coordination with the revised ONR Expeditionary Warfare Program will occur.

Transition Plan

Should the technologies being investigated in the OTH Comm sub-task prove to be beneficial, they could be transitioned to an acquisition program FY98. Coordination of the development of a UAV communications package will be conducted with the Program Manager for Communications (PM Comm). Because there is now a joint effort with ONR/N85, a transition probability exists with the Navy. Initial coordination is already underway with DARPA to keep them abreast of our efforts in this area as they pursue the development of a communication package for the TIER-2+ UAV.

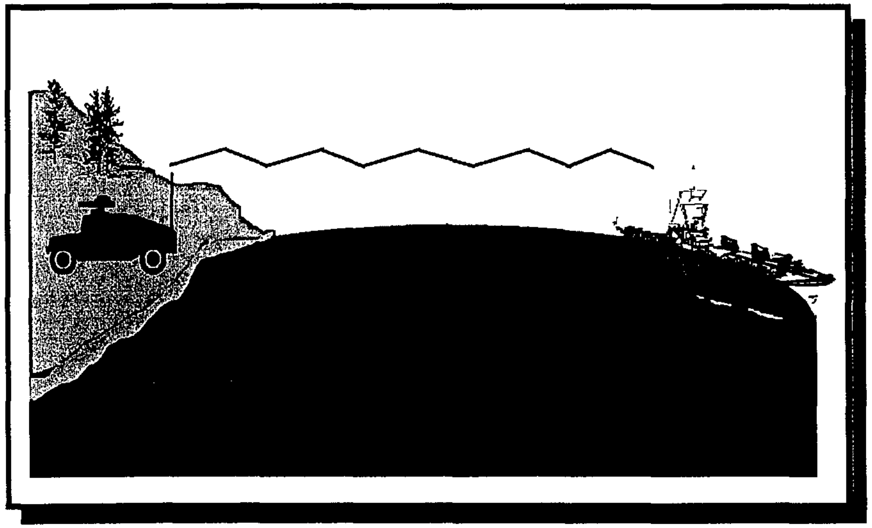
Relationship to Other Programs

The technologies involved in the OTH Comm effort are, in some cases, being used in other fielded systems. Therefore, this sub-task is tied to those programs in this manner. Coordination with DARPA, ONR, and Space and Naval Warfare Command (SPAWAR) will occur to ensure any developing UAV communication relay requirements support the USMC OTH Comm approach.

OTH Comm technology work is also being coordinated with the CWL demonstrations for Sea Dragon and the BADD technology used by the Army.

THIS PAGE INTENTIONALLY LEFT BLANK.

COMMUNICATIONS



APPROACH:

- UPFRONT TECH REVIEW AND ROADMAP
- MAXIMIZE INTERFACE ON JT/DoD DEVELOPMENTS
- JOINT EFFORT ON OVER THE HORIZON COMMS WITH BOTH ONR EXPEDITINARY WARFARE COMMS DIVISION AND ONR LITTORAL INTERNET WORKING PROJECT.
- CECOM JOINT INTEROPERABILITY TECHNOLOGY IDENTIFICATION AND DEVELOPMENT
- PARTICIPATE IN DARPA TACTICAL FIBER EXTENSION PROJECT
- SPEAKEASY RADIO AND DACT NETWORKING TECHNOLOGY ENHANCEMENTS

PERFORMING ACTIVITIES:

- NRaD
- CECOM

OBJECTIVE:

- ID, DEVELOP, AND DEMO ROBUST DIGITAL COMMS THAT ENABLE SEAMLESS COMMUNICATIONS SUPPORT FOR OPERATIONAL MANEUVER FROM THE SEA
- PROVIDE IMPROVED CAPABILITY FOR COVERT (LPI/LPD), LOW POWER, VOICE/DIGITAL DUAL USE COMMS
- INTEGRATE NEW TECHNOLOGIES TO PROMOTE JOINT EXPEDITIONARY FORCE INTEROPERABILITY

CAPABILITIES:

- COMMS: COVERT, HIGH SPEED (INCL IMAGERY), WORLDWIDE (R-Q1)
- NON-OBTRUSIVE ID (R Q1)
- REAL-TIME HIGH DATA RATE INTEL PROCESSING/AALYSIS TAILORED TO USER (R Q2)

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
USMC COMMS ASSESSMENT/TECH ROADMAP		△	△	
OTH AIRBORNE RELAY DESIGN AND ANALYSIS		△		
EVAL OF ULTRA-WIDE BAND COMMS TECHNOLOGY	▲		△	
LEO SATELLITE/OTH COMMS ASSESSMENT FOR CWL	▲			
SPEAKEASY/DACT NETWORKING TECH		△		△

TRANSITION:

- DIR C4I, PM COMMS, NAVSEA, US ARMY CECOM

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 3. SOFTWARE/INTEGRATION

Problem/Deficiency

MAGTF C4I systems in operation today are "stovepipe" in nature and lack interoperability capabilities. Computer based systems for C2 must be interoperable to reap full benefit of the information infrastructure supported by the computer. With the trend toward joint operations, the Marine Corps is in the process of migrating their MAGTF C4I software into the GCCS Common Operating Environment (COE) to take advantage of the infrastructure provided.

Technical Objectives/Expected Payoffs

Software applications developed using the COE can be shared by other organizations requiring similar functionality. Each Service needs to implement only those applications that are unique to a specific user.

Technical Background and Approach

This task was formerly called 'Computers'. For FY97 the task has been renamed 'Software/Integration'. This is basically a MCTSSA task in which NRaD will provide support for software and integration to ensure a smooth transition for to operational systems for prototypes developed in the technology environment.

Summary of Prior and Current Years' Work

Two prototype systems that were developed under the Computer task area were transitioned to MCTSSA in FY96. User evaluation of the AAP was conducted during an amphibious exercise conducted in May 1996. The KELT prototype underwent user evaluation during the ULCHI Focus Lens (UFL) exercise in Korea in August 1996.

Planned Work

This task will be defined by MCTSSA, FY97 will be the first year for funding of this effort.

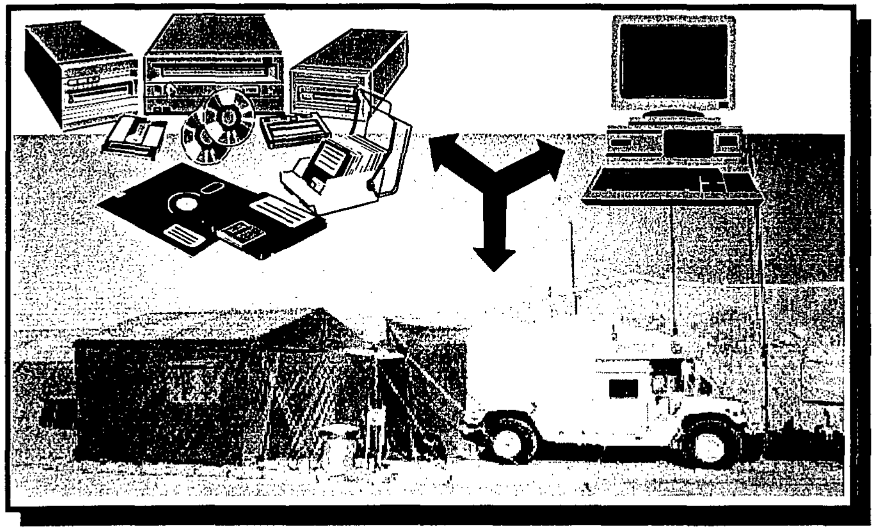
Transition Plan

Under this task the software will be transitioned and integrated into the MAGTF C4I Software Baseline (MSBL) being developed by MCTSSA.

Relationship to Other Programs

All software will be compatible with the GCCS COE and the Global Combat Service Support (GCSS) system distributed by DISA.

SOFTWARE/INTEGRATION



OBJECTIVE:
- PROVIDE DEDICATED SOFWARE TECHNOLOGY INTEGRATION AND ANALYSIS SUPPORT FOR RAPID EARLY USER EVALUATION AND BASELINE MIGRATION
- ESTABLISH JOINT TACTICAL COMMUNICATIONS INTEROPERABILITY DEVELOPMENT AND TECHNOLOGY EVALUATION WITH US ARMY CECOM

CAPABILITIES:
- "VISION 2010" INTEROPERABILITY
- INTEROPERABLE, DISTRIBUTED, EMBEDDED FOR ALL COMBAT SYSTEMS (Y Q1)
- MERGED M&S AND C2 SYSTEMS (Y Q1))

APPROACH:
- ESTABLISH SOFTWARE TECHNOLOGY INSERTION GROUP FOR GROUND COMBAT AND LOGISTICS C4I SYSTEMS INTEGRATION AND ANALYSIS - MCTSSA (AWT) & CECOM (AWT)
- DEVELOP COOPERATIVE JOINT C4I INTEROPERABILITY TECH DEVELOPMENT EFFORTS WITH US ARMY

PERFORMING ACTIVITIES:
- MCTSSA, CECOM

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
INTEROPERABILITY SOFTWARE TECH ROADMAP		△ △		
ID JOINT DEVELOPMENT TARGET OPPORTUNITIES		△		
TECH INSERTION SUPPORT TO MAGTF C4I BASELINE	▲			△
JOINT C4I TECHNOLOGY DEVELOPMENT TEAMING	▲			△

TRANSITION:
- DIR C4I, PM COMMS
- MCTSSA, DPM SOFTWARE

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 4. INTELLIGENCE

Problem/Deficiency

There are a number of "new" RF waveforms now being used in the commercial sector that have potential for use on the modern battlefield. Development of innovative waveforms to support commercial concerns, such as cellular telephones, both analog and digital, and spread spectrum technology have the potential for similar use in a military environment. The drive for frequency reuse within the limited RF bandwidth has caused manufacturers to build systems that use very low power output levels and spreading techniques. These characteristics make the collection of these signals very difficult both in terms of locating the signal and capturing it. Current military inventories of signals collection equipment, especially those suites designed for use in the tactical environment (close to the forward edge of the battle area (FEBA)), are inadequate to support C2W.

There is also a requirement to increase the amount, type, and quality of intelligence available from imagery. While national, strategic, and tactical assets are capable systems, the Corps also recognizes the benefits derived from having tactical imagery from sources close to the point of interest. The ability for infantry forces, mechanized or foot mobile Marines, to gather imagery intelligence (IMINT) needs to be more fully exploited. While the taking of pictures has been standard fare for some time, the challenge now is to capture both still and video images in digital form and transmit them to the appropriate point in a timely manner.

Growth of advanced commercial personal communication and data processing equipment presents a potential problem for the USMC forces. These advances enable adversaries to build very capable C2 systems and provide them with greater capabilities to degrade US force C2 systems through anti-radio techniques, information terrorism and blockade, and system incapacitation. The need exists for US forces to have the capability to attack potential adversary C2 information systems with hard and/or soft kill capabilities.

Technical Objectives/Expected Payoffs

The technical objective of this task is to exploit Commercial Off the Shelf (COTS) and Government Off the Shelf (GOTS) technologies that enable tactical systems amenable for field use. The objective is to provide immediate capability enhancements through rapid technology insertion into current systems. If required, or if the technology appears favorable, new system designs could be considered for future efforts. The payoffs will be enhanced intelligence collection capability from forces closer to the FEBA and closer to the target and the ability to counter emerging C2 threats through IW methods.

Technical Background and Approach

Current systems are large and, in the case of signals collection, incomplete in their ability to meet and defeat emerging threats. The systems must be small, rugged, and user friendly so that the Marines will not be overly encumbered by excessive weight, volume, or difficulty of use. The shortcomings and true capability requirements will be determined through interaction with the users and developers of current systems. COTS and GOTS technologies will then be canvassed to determine what is available for immediate use to satisfy the defined requirement. If technology is available for rapid insertion, a prototype system could be developed and evaluated. In the absence of supporting technology, a tech base effort would be considered in order to develop the required capability.

For the IW effort, the approach is to simultaneously develop weapons, CONOP, and C2 systems which will provide capabilities to counter the IW threat. This will be done by surveying ongoing work in IW areas. A USMC requirements analysis will be performed to match the requirements to available technology. The technology will be implemented and a proof-of-concept demonstration, based on USMC specific requirements, will be performed.

Summary of Prior and Current Years' Work

A critical mission requirements document was written identifying the critical requirements for the next generation Handheld Signal Locating System (HSLS) for use by US Marine Corps RRTs in the year 2000 and beyond. It identifies three mission scenarios for use of the HSLS: harbor transit; tactical recovery of aircraft and personnel (TRAP); and, hostage rescue. Specific target signal attributes, size and portability requirements, self-location capability (i.e., GPS), integration of digitized map data capability, and input/output parameters are also discussed.

The Digital Video Imagery task was revised in FY96 to investigate video compression algorithms to meet a more critical bandwidth deficiency when transmitting large imagery files over the network. A demonstration prototype of the compression technology was demonstrated at the end of FY96.

There is no prior or current year summary for the IW subtask since it is a new start in FY97.

Planned Work

For the HSLS effort, component systems will be procured and a technology demonstration system test bed will be assembled. The test bed will be exercised using various terrain and operator situations to validate the concepts developed during the FY96 effort. The line of bearing (LOB) accuracies will be verified for a number of different frequencies. A demonstration of the concept will also be performed.

For the IW sub-task, a study will be performed to identify, analyze, and forecast the general types of systems to be targeted based on a survey of intelligence community work. Related research programs, MARCORSYSCOM Small Business Innovative Researches (SBIRs), and other Service programs will also be considered. An IW CONOP will be developed for both hard kill and soft kill IW weapons including, as appropriate, weapons cuing concepts. The technology will be demonstrated in a USMC context. M&S will also be used to aid in the prevention of fratricide. Optimum reuse of existing government developed software applications is planned.

Transition Plan

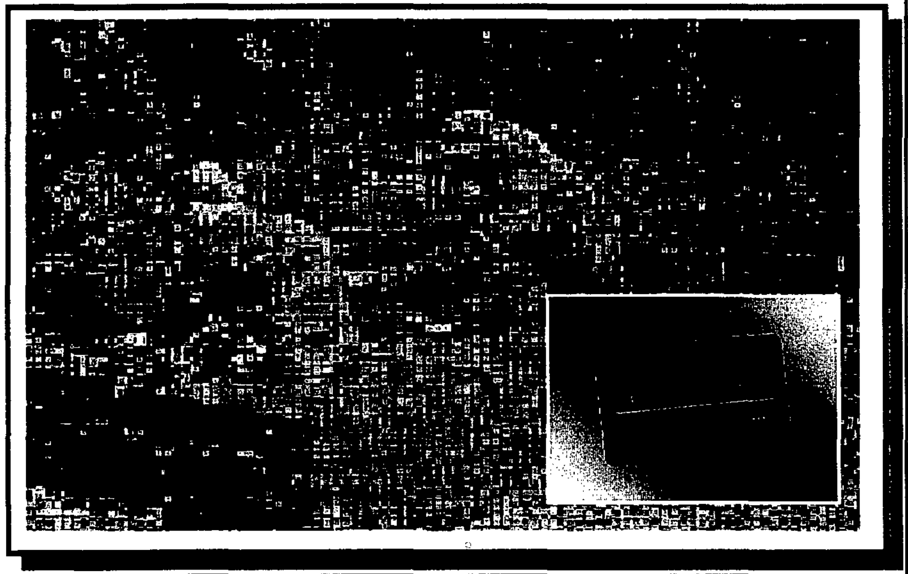
The radio reconnaissance and digital imagery technologies will be transitioned to the MARCORSYSCOM PM for Intelligence Systems (PM INTEL) for integration into current intelligence systems. Capabilities developed under the IW subtask will probably be integrated into the planned IW ATD.

Relationship to Other Programs

This work will be done in direct support of the USMC efforts: Radio Reconnaissance Equipment Program (RREP) and Manpack SIDS. The IW subtask will be coordinated closely with other IW efforts being conducted by PM INTEL, USMC Headquarters, and related SBIR tasks.

THIS PAGE INTENTIONALLY LEFT BLANK.

INTELLIGENCE



APPROACH:

- SUPPORT USMC IW SYSTEM FAILURE ANALYSIS
- ID AND DEVELOP IW PROTECTION TECHNOLOGIES
- DEVELOP HAND-HELD SIGNAL LOCATING DEVICE CONCEPTS FOR DETECTION AND LOCATION OF SIGNALS FROM 20 - 1000 MHZ, WITHIN 5 KM
- TEST AND EVALUATE HYDRAH SYSTEMS CONCEPTS FOR FORWARD RECON APPLICABILITY
- DEVELOP NEW TECHNOLOGIES FOR RADIO BN FORWARD AREA INTELLIGENT JAMMING

PERFORMERS:

- LAB: NRaD
- CONTRACTOR: AR INC

OBJECTIVE:

- DEVELOP INFORMATION WARFARE (IW) SYSTEMS TO PROTECT MAGTF COMMAND AND CONTROL INFO SYSTEMS
- PROVIDE FORWARD RADIO RECON HAND-HELD RF SIGNAL DETECTION/LOCATION CAPABILITY

CAPABILITIES:

- NRAC IW OUTBRIEF RECOMMENDATIONS
- MULTISPECTRAL C2 DETECTION/LOCATION (R-Q1)
- INTRUSION INTO ENEMY NETWORKS (R-Q1)
- MULTI-ECHELON ELECTRONIC ATTACK (R-Q1)
- IMPROVED MULTISPECTRAL ELECTRONIC ATTACK (R-Q2)

SCHEDULE:

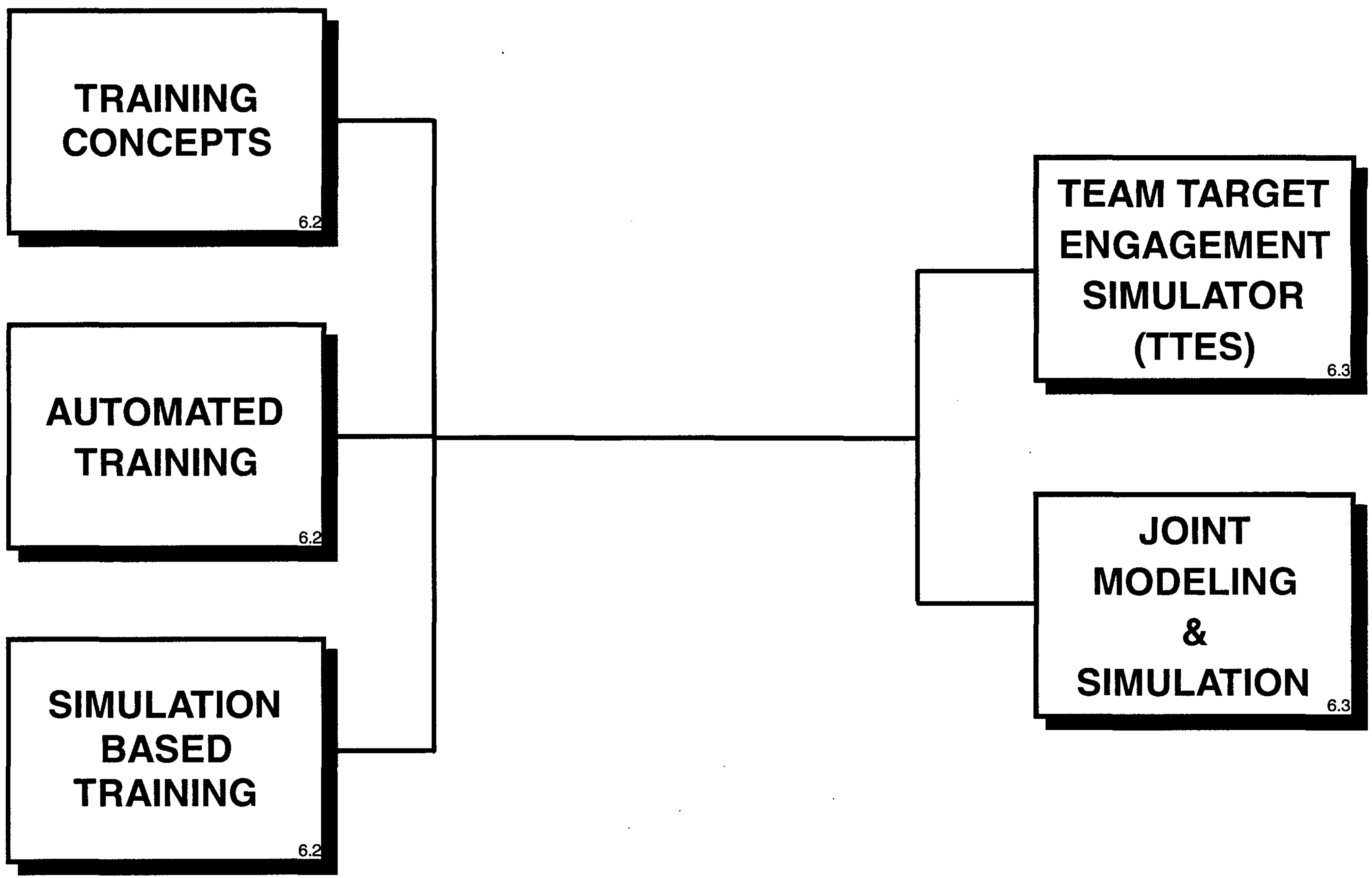
TASKS	FY96	FY97	FY98	FY99
USMC IW SYSTEM ANALYSIS	▲		△	
SURVEY/ANALYSIS RR ANTENNAS	▲	△		
EVALUATE HYDRAH & OTHER RR PROTOTYPES	▲		△	
ID, DEV & DEMO IW PROTECTION TECH		△		△
DEVELOP & EVALUATE FORWARD AREA JAMMING CONCEPTS		△	△	

TRANSITION:

- DIR C4I (PM INTEL), MCTSSA DPM SOFTWARE

THIS PAGE INTENTIONALLY LEFT BLANK.

TRAINING AND EDUCATION IMPERATIVE



NOTE: SEE 6.3 PLAN FOR ALL 6.3 PROJECTS.

THIS PAGE INTENTIONALLY LEFT BLANK.

Imperative Title: TRAINING AND EDUCATION

THIS PAGE INTENTIONALLY LEFT BLANK.

TRAINING AND EDUCATION IMPERATIVE

PROJECT OBJECTIVES AND TECHNOLOGY THRUSTS

The principal objective of this project is to develop and demonstrate the technologies and concepts to enhance the capability of Marine Corps Combat Elements to prepare for combat and combat support operations.

This objective will be achieved by providing enhanced training in a variety of areas and through a variety of methods including initial through sustainment training and individual combatant through high level staff training. Specific technical areas of interest are: training automation, integration training with operational systems, and maximum use of simulation to enhance training.

STRUCTURE AND TASK IDENTIFICATION INCLUDING OUTYEAR NEW STARTS

This project will have three tasks during the first year of execution as shown in the project outline. Work within the tasks shown in this plan may be extended beyond that shown to allow for product improvements. Additional tasks will be planned and implemented in the outyears as a result of concept development milestones to be completed in the first several years. All tasks will comply with the principal objective and technical thrust for the project.

THIS PAGE INTENTIONALLY LEFT BLANK.

TRAINING AND EDUCATION IMPERATIVE FUNDING ($K)

TASK NO	PERFORMER	FY96 CURRENT FY	FY97 EXECUTION FY	FY98 BUDGET FY	FY99 BY+1 FY	FY00 BY+2 FY
1	NAWC-TSD	0	50	50	50	70
	CONTRACT	0	350	250	250	250
2	NAWC-TSD	0	50	50	50	70
	CONTRACT	0	200	250	250	300
3	NAWC-TSD	0	50	50	50	59
	CONTRACT	0	200	225	300	300
PROJECT TOTALS		0	900	875	950	1,049

TASK NO.	TITLE
1	TRAINING CONCEPT
2	AUTOMATED TRAINING
3	SIMULATION BASED TRAINING

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: TRAINING AND EDUCATION

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 1. TRAINING CONCEPTS														
A. Technology Assessment					S				C					
B. Hardware/Software Concepts Development							S				C		S	C
C. Hardware/Software Development (Phase I)								S			H		C	
D. Hardware/Software Test (Phase I)												S	C	
E. Hardware/Software Development (Phase II)													S	H
F. Hardware/Software Demo and Transition (Phase I)													DR(1)	T
G. Hardware/Software Test (Phase II)														
H. Hardware/Software Demo and Transition (Phase II)														
I. Advanced Warfighting Experiment/Limited Operational Exercise/ACTD Participation									O				O	O

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

--- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Final reports for external distribution.

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: TRAINING AND EDUCATION (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 2. AUTOMATED TRAINING														
A. Technology Assessment					S				C					
B. Hardware/Software Concepts Development							S						C	
C. Hardware/Software Development (Phase I)								S			H		C	
D. Hardware/Software Test (Phase I)												S	C	
E. Hardware/Software Development (Phase II)													S	H C
F. Hardware/Software Demo and Transition (Phase I)													DR(1)	T
G. Hardware/Software Test (Phase II)														S
H. Hardware/Software Demo and Transition (Phase II)														
I. Advanced Warfighting Experiment/Limited Operational Exercise/ACTD Participation									O				O	O

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Final reports for external distribution.

THIS PAGE INTENTIONALLY LEFT BLANK.

IMPERATIVE: TRAINING AND EDUCATION (CONTINUED)

MILESTONE DESCRIPTION	FY96 CURRENT YEAR (QUARTERS)				FY97 EXECUTION YEAR (QUARTERS)				FY98 BUDGET YEAR (QUARTERS)				FY99 (BY+1)	FY00 (BY+2)
	1	2	3	4	1	2	3	4	1	2	3	4		
TASK 3. SIMULATION BASED TRAINING														
A. Technology Assessment					S				C					
B. Hardware/Software Concepts Development							S						C	
C. Hardware/Software Development (Phase I)								S			H		C	
D. Hardware/Software Test (Phase I)												S	C	
E. Hardware/Software Development (Phase II)													S	H C
F. Hardware/Software Demo and Transition (Phase I)													DR(1)	T
G. Hardware/Software Test (Phase II)														
H. Hardware/Software Demo and Transition (Phase II)														S
I. Advanced Warfighting Experiment/Limited Operational Exercise/ACTD Participation									O				O	O

MILESTONE SYMBOL LEGEND

S = Start
C = Complete
D = Major Demo
H = Hardware Available
T = Transition
R = Report
O = Other

---- Indicates Slippage
Symbol without underline indicates PLANNED
Underlined symbol indicates ACTUAL
Notes are provided for necessary clarification

NOTES:

1. Final reports for external distribution.

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 1. TRAINING CONCEPTS

Problem/Deficiency

The Marine Corps mission necessitates a highly trained force capable of accomplishing an extremely wide variety of tasks in combat and combat support operations. Due to the ever increasing requirements associated with these tasks, initial training of all personnel and sustainment training are vitally important. Current training tools are marginally capable of accomplishing the required training and, in many cases, fall short of requirements.

New training concepts are needed to allow personnel to attain and maintain skills necessary for future operational needs of the Marine Corps.

Technical Objective/Expected Payoffs

The technical objective is to provide an enhanced training capability for all levels and phases of training required.

The expected payoff is the enhanced combat capability of Marine Corps Combat Elements in combat and combat support operations. Marine units at multiple levels, from Marine Expeditionary Force (MEF) to squad and down to the individual, will be able to train in as realistic a manner as is possible short of true combat operations. Training will take less time and will yield a more qualified trainee.

Technical Background and Approach

Current military training systems do not take full advantage of current and emerging technology.

This project will begin with a concept development phase to determine the scope and focus of the project. Specific points of interest are: simulation based training concepts, automated training concepts, concepts for integration of training and operational systems, training while deployed, and intelligent counterpart development. Factors to be considered in choosing concepts for further development are: relation to needs, current levels of technical maturity for related technologies, and cost levels associated with candidate courses of action. This first phase will provide that basic technology which can be transitioned within three years with the second phase improving upon the first phase technology or exploring new concepts. Hardware/software development, testing, and demonstration will be done in each phase.

Summary of Current Year's Work

This is a new start for FY97.

Planned Work

The focus of the first year effort will be a technical review and limited technical concept development to determine the appropriate scope and focus of the project. Following this will be development of one or more concepts. Breadboard hardware/software will be demonstrated prior to transition. Limited evaluation of NDI and COTS Items will also be conducted.

Transition Plan

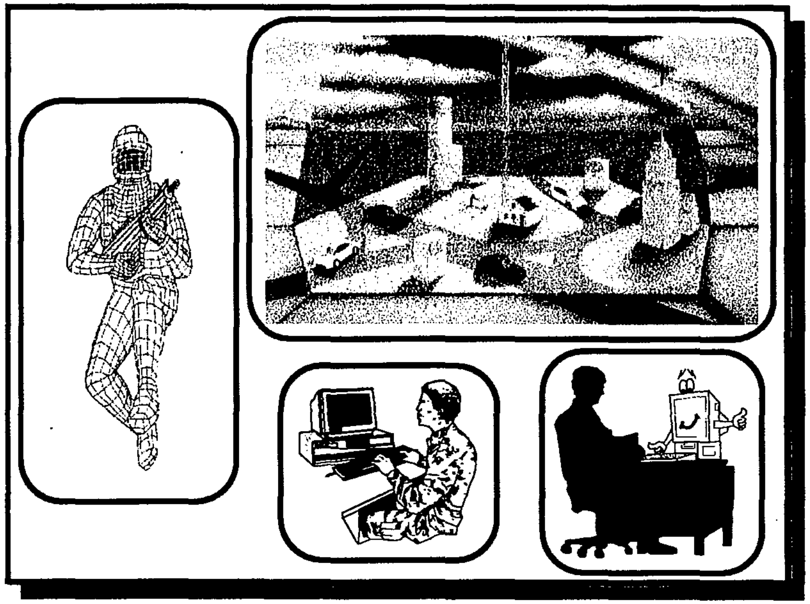
This project is a new start, planned to last through FY01. Because the hardware and software concepts have not yet been finalized, specific transition plans have not been identified. Transition will be to one or several 6.3 efforts in FY99 and FY00. Specifically, this project will provide technology to benefit the Family of Marine Corps Training Simulators program as well as other individual and related military operational simulations. A joint ATD with DARPA and the US Army will be pursued.

In addition, selected technologies will participate in the Urban Warrior and Capable Warrior Advanced Warfighting Experiments (AWEs), as well as the Sea Dragon and MOUT ACTD's.

Relationship to Other Programs

This project will leverage technology from other training and education programs to the maximum extent possible. Specific opportunities and relationships will be identified during the concepts development stage. Probable transition programs: MAGTF Individual Combat Simulation System (MICSS) RIS.

TRAINING CONCEPTS



OBJECTIVE:

- SIGNIFICANTLY ENHANCED INDIVIDUAL AND SMALL UNIT TRAINING FROM ENTRY LEVEL THROUGH SUSTAINMENT WITH NEW CONCEPTS FOR MISSION REHEARSAL, ACCELERATED TRAINING, TRAINING WHILE DEPLOYED, AND INTEGRATION OF TRAINING AND OPERATIONAL SYSTEMS. ADDRESS CPG TRAINING AND EDUCATION

CAPABILITIES:

- DECISION MAKING TRAINING (R-Q1)
- INTEROPERABLE, DISTRIBUTED AND IMBEDDED TRAINING (Y-Q1)
- INCREASED REALISM IN TRAINING (Y-Q1)
- SYSTEMS FOR SELF TRAINING (CWL)
- ADVANCED TRAINING FACILITIES (CWL)
- MODELING AND SIMULATION CENTERS MNS

APPROACH:

- IDENTIFY HIGH PAY-OFF TRAINING CONCEPTS/TECHNOLOGY OPPORTUNITIES
- FOCUS ON AUTOMATED TRAINING AND INTELLIGENT SYSTEMS
- DEVELOP AND INTEGRATE SIMULATION BASED TRAINING TECHNOLOGIES - INTEGRATE LIVE, VIRTUAL AND CONSTRUCTIVE
- LEVERAGE AND INTEGRATE TTES, RIS, MICSS, TLDHS, AND OTHER PROGRAMS
- SUPPORT URBAN WARRIOR AND CAPABLE WARRIOR AWE/LOEs
- PARTICIPATE IN MOUT AND SEA DRAGON ACTDs
- TRANSITION TECHNOLOGIES AND SUB-SYSTEMS TO DEMONSTRATION

PERFORMERS:

- NAWC-TSD, SWRI, STRICOM, NPRDC, SWRI

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
TECHNOLOGY ASSESSMENT		△———	△	
HARDWARE/SOFTWARE CONCEPTS DEVELOPMENT		△———	———	———△
HARDWARE/SOFTWARE TEST			△———	———△
HARDWARE/SOFTWARE DEMO & TRANSITION				△
AWE/LOE/ACTD		△	△	△

TRANSITION:

- PM - SST - MAGTF INDIVIDUAL COMBAT SIMULATION SYSTEM (MICSS), RANGE INSTRUMENTATION SYSTEMS (RIS)
- U.S. ARMY STRICOM
- PM - CBG - TARGET LOCATION DIRECTION HANDOFF SYSTEM (TLDHS)

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 2. AUTOMATED TRAINING

Problem/Deficiency

The Marine Corps mission necessitates a highly trained force capable of accomplishing an extremely wide variety of tasks in combat and combat support operations. Due to the ever increasing requirements associated with these tasks, initial training of all personnel and sustainment training are vitally important. Current training tools are marginally capable of accomplishing the required training and, in many cases, fall short of requirements. Detailed, refresher training is often most efficiently accomplished via self paced study with automated aids as opposed to a classroom environment or instruction by another person.

Technical Objective/Expected Payoffs

The technical objective is to provide an enhanced training capability for all levels and phases of training required.

The expected payoff is the enhanced combat capability of Marine Corps Combat Elements in combat and combat support operations. Marine units at multiple levels, from MEF to squad and down to the individual, will be able to train in as realistic a manner as is possible short of true combat operations. Training will take less time and will yield a more qualified trainee.

Technical Background and Approach

Current military training systems do not take full advantage of current and emerging technology.

This project will begin with a concept development phase to determine the scope and focus of the project. Specific points of interest are: intelligent systems, concepts for integration of training and operational systems, and training while deployed. Factors to be considered in choosing concepts for further development are: relation to needs, current levels of technical maturity for related technologies, and cost levels associated with candidate courses of action. The first phase will provide that basic technology which can be transitioned within three years with the second phase improving upon the first phase technology or exploring new concepts. Hardware/software development, testing, and demonstration will be done in each phase. Development will take place in two phases providing mid-term and far-term training capabilities.

Summary of Current Year's Work

This is a new start for FY97.

Planned Work

The focus of the first year effort will be a technical review and limited technical concept development to determine the appropriate scope and focus of the project. Following this will be development of one or more concepts. Breadboard hardware/software will be demonstrated prior to transition. Limited evaluation of NDI and COTS Items will also be conducted.

Transition Plan

This project is a new start, planned to last through FY01. Because the hardware and software concepts have not yet been finalized, specific transition plans have not been identified. Transition will be to one or several 6.3 efforts in FY99 and FY00. Specifically, this project will provide technology to benefit the entire Marine Corps training system. A joint ATD with DARPA and the US Army will be pursued.

In addition, selected technologies will participate in the Urban Warrior and Capable Warrior AWEs, as well as the Sea Dragon and MOUT ACTD's.

Relationship to Other Programs

This project will leverage technology from other training and education programs to the maximum extent possible. Specific opportunities and relationships will be identified during the concepts development stage. Probable transition programs: MICSS RIS.

AUTOMATED TRAINING

OBJECTIVE:

- SIGNIFICANTLY ENHANCE INDIVIDUAL AND SMALL UNIT TRAINING FROM ENTRY LEVEL THROUGH SUSTAINMENT THROUGH USE OF AUTOMATED TRAINING PROCESSES

CAPABILITIES:

- DECISION MAKING TRAINING (R-Q1)
- INTEROPERABLE AND IMBEDDED TRAINING (R-Q1)
- SYSTEMS FOR SELF TRAINING (CWL)
- ADVANCED TRAINING FACILITIES (CWL)
- MODELING AND SIMULATION CENTERS MNS

APPROACH:

- DEVELOP AND ANALYZE CONCEPTS FOR STREAMLINING TRAINING PROCESSES THROUGH AUTOMATION
- DETERMINE TRAINING OPPORTUNITIES
- LEVERAGE AND INTEGRATE OTHER USMC AND JOINT TRAINING PROGRAMS - MICSS, TLDHS
- SUPPORT CWL AWE/LOE/ACTD PREPARATIONS - URBAN WARRIOR AND CAPABLE WARRIOR
- PARTICIPATE IN MOUT AND SEA DRAGON ACTDs
- FOCUS ON INTELLIGENT SYSTEMS AND COGNITIVE ANALYSIS

PERFORMERS:

- NPRDC, STRICOM, NAWC-TSD

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
TECHNOLOGY ASSESSMENT		△	△	
HARDWARE/SOFTWARE CONCEPTS DEVELOPMENT		△		△
HARDWARE/SOFTWARE TEST			△	△
HARDWARE/SOFTWARE DEMO & TRANSITION				△
AWE/LOE/ACTD			△	△ △

TRANSITION:

- PM-SST - TLDHS TRAINER
- U.S. ARMY STRICOM
- PM-CBG - MAGTF INDIVIDUAL COMBAT SIMULATION SYSTEM (MICSS)

THIS PAGE INTENTIONALLY LEFT BLANK.

TASK 3. SIMULATION BASED TRAINING

Problem/Deficiency

The Marine Corps mission necessitates a highly trained force capable of accomplishing an extremely wide variety of tasks in combat and combat support operations. Due to the ever increasing requirements associated with these tasks, initial training of all personnel and sustainment training are vitally important. Current training tools are marginally capable of accomplishing the required training and, in many cases, fall short of requirements.

The specific environments and situations needed to accomplish Marine Corps missions are often difficult to replicate for training. Likewise, training in such environments and situations is difficult to evaluate and integrate into complete training packages. Lastly, facilities, funding, and time limit training opportunities. Alternative methods for the full spectrum of training requirements are needed.

Technical Objective/Expected Payoffs

The technical objective is provide an enhanced training capability for all levels and phases of training required through the use of simulation.

The expected payoff is the enhanced combat capability of Marine Corps Combat Elements in combat and combat support operations. Marine units at multiple levels, from MEF to squad and down to the individual, will be able to train in as realistic a manner as is possible short of true combat operations. Training will take less time and will yield a more qualified trainee. A reliable method of training evaluation will also be available.

Technical Background and Approach

Current military training systems do not take full advantage of current and emerging technology.

This project will begin with a concept development phase to determine the scope and focus of the project. Specific points of interest are: linking of different size units at geographically remote sites, concepts for integration of training and operational systems, and training while deployed. Factors to be considered in choosing concepts for further development are: relation to needs, current levels of technical maturity for related technologies, and cost levels associated with candidate courses of action. The first phase will provide that basic technology which can be transitioned within three years with the second phase improving upon the first phase technology or exploring new concepts. Hardware/software development, testing, and demonstration will be done in each phase. Development will take place in two phases providing mid-term and far-term training capabilities.

Summary of Current Year's Work

This is a new start for FY97.

Planned Work

The focus of the first year effort will be a technical review and limited technical concept development to determine the appropriate scope and focus of the project. Following this will be development of one or more concepts. Breadboard hardware/software will be demonstrated prior to transition. Limited evaluation of NDI and COTS Items will also be conducted.

Transition Plan

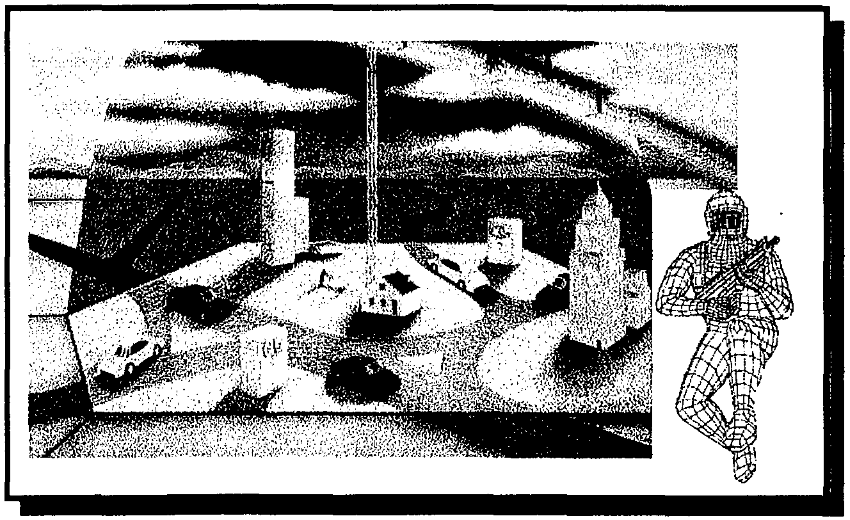
This project is a new start, planned to last through FY01. Because the hardware and software concepts have not yet been finalized, specific transition plans have not been identified. Transition will be to one or several 6.3 efforts in FY99 and FY00. Specifically, this project will provide technology to benefit the entire Marine Corps training system. A joint ATD with DARPA and the US Army will be pursued.

In addition, selected technologies will participate in the Urban Warrior and Capable Warrior AWEs, as well as the Sea Dragon and MOUT ACTD's.

Relationship to Other Programs

This project will leverage technology from other training and education programs to the maximum extent possible. Specific opportunities and relationships will be identified during the concepts development stage. Probable transition programs: MICSS RIS.

SIMULATION BASED TRAINING



OBJECTIVE:

- SIGNIFICANTLY ENHANCE INDIVIDUAL AND SMALL UNIT TRAINING FROM ENTRY LEVEL THROUGH SUSTAINMENT USING SIMULATION BASED TRAINING TECHNOLOGIES

CAPABILITIES:

- DECISION MAKING TRAINING (R-Q1)
- INCREASED REALISM IN TRAINING (Y-Q1)
- INTEROPERABILITY, DISTRIBUTED, INTEGRATED TRAINING (Y-Q1)
- SYSTEMS FOR SELF TRAINING (CWL)
- ADVANCED TRAINING FACILITIES (CWL)
- MODELING AND SIMULATION CENTERS MNS

APPROACH:

- IDENTIFY AND DEVELOP HIGH PAY-OFF SIMULATION BASED TRAINING CONCEPTS AND TECHNOLOGY
- LEVERAGE AND INTEGRATE TTES, RIS, MICSS, TLDHS AND OTHER TRAINING PROGRAMS
- SUPPORT AWE/LOE URBAN WARRIOR AND CAPABLE WARRIOR
- PARTICIPATE IN MOUT, SEA DRAGON AND JOINT COUNTERMINE ACTDs
- FOCUS ON INTEGRATION OF VIRTUAL AND CONSTRUCTIVE SIMULATIONS

PERFORMERS:

- SWRI, STRICOM, NAWC-TSD

SCHEDULE:

TASKS	FY96	FY97	FY98	FY99
TECHNOLOGY ASSESSMENT		△	△	
HARDWARE/SOFTWARE CONCEPTS DEVELOPMENT		△		△
HARDWARE/SOFTWARE TEST			△	△
HARDWARE/SOFTWARE DEMO & TRANSITION				△
AWE/LOE/ACTD		△	△	△

TRANSITION:

- PM-SST - TTES, RIS, MICSS
- U.S. ARMY
- PM-CBG - TLDHS TRAINER

THIS PAGE INTENTIONALLY LEFT BLANK.

ANNEX A

THE COMBAT DEVELOPMENT PROCESS

The Marine Corps Combat Development Command (MCCDC) owns the Combat Development Process (CDP). It is from the CDP that both formal and informal requirements flow. Even though Applied Research (6.2) efforts are legitimate even in the absence of formal documentation such as Mission Needs Statements (MNS) and Operational Requirements Documents (ORD), the CDP is looked to for needs and requirements upon which to base 6.2 investment decisions. The Science and Technology (S&T) Roundtable has fortuitously been a mechanism of convenience that also seems to bring together the MCCDC proponents and the Marine Corps Systems Command (MARCORSYSCOM) operatives in a collegial environment to work the very complex challenge of identifying, agreeing to, and prioritizing capability deficiencies to which technology might be applied.

The CDP is composed of three components as follows:

The Concept Based Requirements System (CBRS) which:
- Develops the concepts
- Assesses the capabilities
- Determines the requirements

The Solution Development System (SDS) which:
- Meets the requirement through one or more of five solutions:
  - Doctrine
  - Organization
  - Equipment
  - Training & Education
  - Support/Facilities

The Capability Support System (CSS) which:
- Updates
- Maintains
- Reviews

CONCEPT BASED REQUIREMENTS SYSTEM

The Marine Corps Master Plan (MCMP) process is a biennial effort that provides direction to program developers to optimize resource allocation. The CBRS development process identifies and develops linkages between strategies, operational concepts, and warfighting capability requirements.

Our operational concepts are a direct representation of the Corps' long range "vision". This concept-based process optimizes the capability and versatility of the Marine Corps of the future rather than merely correcting the deficiencies of the past. It forces us to look beyond tomorrow. As such, these concepts are the starting point in the CBRS -- the "front end" of the Marine Corps Enterprise. Figure A-1 portrays how we use the CBRS to transform our concepts into Combat Ready forces.

The Marine Corps Business Enterprise mission is to identify, develop, and field integrated capabilities, based on fundamental concepts, access doctrine, organizations, training and education, equipment, facilities and support, and information to meet the needs and requirements of our customer, the operating forces. Concepts provide a framework for identification and development of future required operational and functional capabilities. These capabilities focus the development efforts for determination of the force structure requirements needed by governmental planning, programming, and oversight agencies.

The CBRS takes higher level guidance and generates the prioritized implementing actions that shape the future Marine Corps. Operational and functional concepts initiate the sequence, providing background, direction, and a listing of broad required capabilities. MAA and Capability Assessments are process activities that are linked to the focus of effort provided in the MCMP. Other source documents include: Fleet Operational Need Statements (FONS), Marine Corps Lessons Learned System (MCLLS), CINC Integrated Priority Lists (IPLs), Joint Mission Area and Support Area (JMA/SA) assessments, and Joint Warfighting Capability Area (JWCA) assessments.

The MAA process analyzes these capabilities and assessments using the detailed functions from the Universal Joint Task List and the Marine Corps operational framework. MAAs identify deficiencies in doctrine, organization, equipment, training and education, and facilities and support. FONS and the MCLLS provide invaluable input and feedback to this process. The MCMP provides the vehicle through which the broad operational capabilities identified in the major concepts are prioritized by the senior leadership. This list becomes the basis for the remainder of the process and provides input to the resource allocation process.

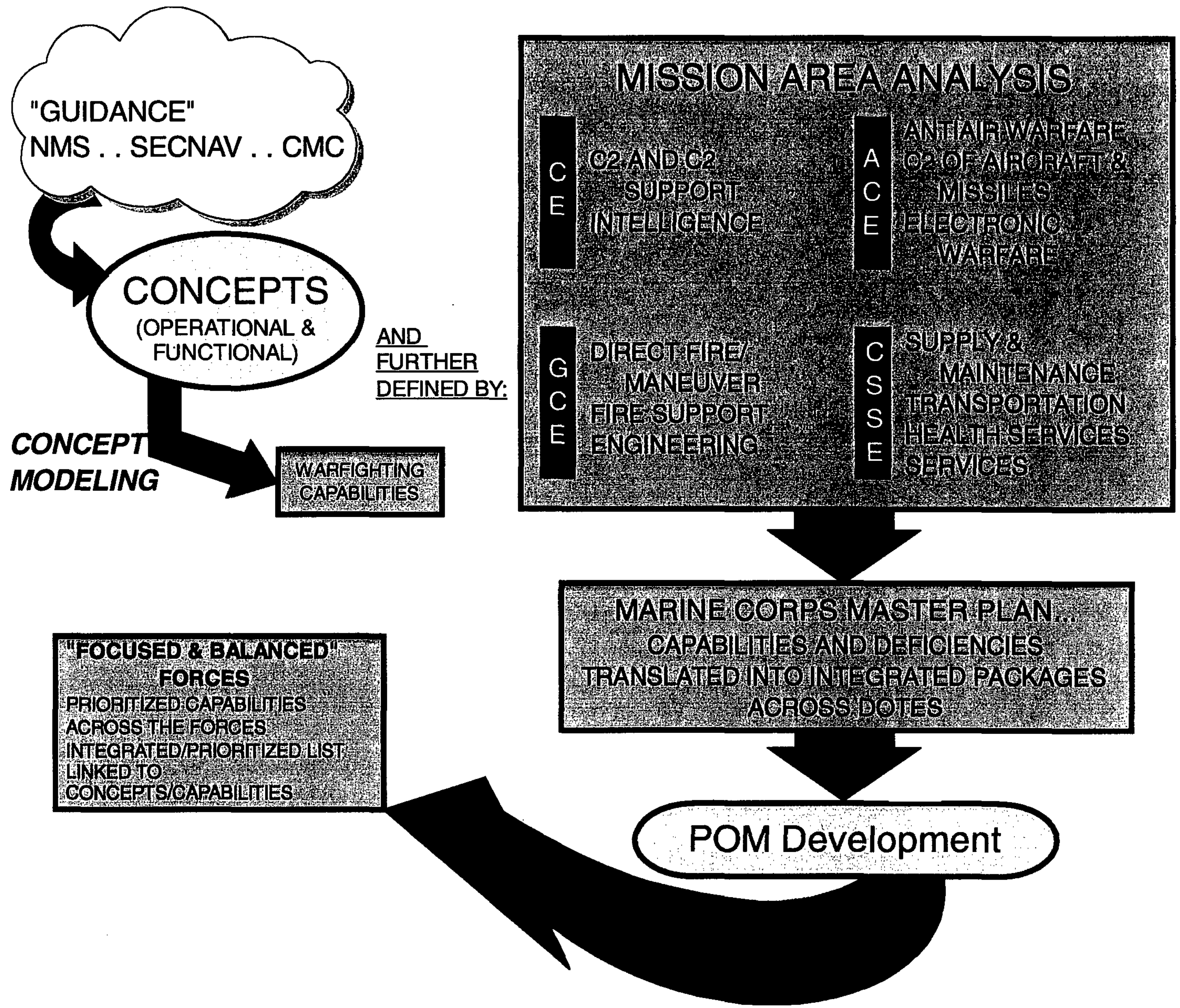


FIGURE A-1. TRANSFORMATION OF CONCEPTS INTO REQUIREMENTS

ACRONYMS
FOR
FIGURE A-1. TRANSFORMATION OF CONCEPTS INTO REQUIREMENTS

ACE	AVIATION COMBAT ELEMENT
C2	COMMAND AND CONTROL
CE	COMMAND ELEMENT
CMC	COMMANDANT OF THE MARINE CORPS
CSSE	COMBAT SERVICE SUPPORT ELEMENT
DOTES	DOCTRINE, ORGANIZATION, TRAINING AND EDUCATION, EQUIPMENT, AND SUPPORT/FACILITIES
GCE	GROUND COMBAT ELEMENT
NMS	NATIONAL MILITARY STRATEGY
POM	PROGRAM OBJECTIVE MEMORANDUM
SECNAV	SECRETARY OF THE NAVY

ANNEX B

THE SCIENCE & TECHNOLOGY ROUNDTABLE PROCESS

The Roundtable process for the Department of the Navy and the Marine Corps is a work in progress. The Navy initially chartered a total of 16 Roundtables. Of these, six were of primary interest to the Marine Corps and the Corps participated in them as follows:

Forward Presence
Surface Battlespace
Command, Control, Communications, Computers, and Intelligence (C4I)
Mine Warfare
Surveillance
Combat Service Support (CSS)

At the conclusion of Roundtable I for these six, it was mutually agreed by Marine Corps Systems Command (MARCORSYSCOM), Marine Corps Combat Development Command (MCCDC), Office of Naval Research (ONR), and Office of the Chief of Naval Operations (OPNAV) that it would be appropriate to charter and conduct a roundtable to address Marine Corps-unique warfighting functions that did not receive the appropriate level of emphasis in the aforementioned Roundtables. The Marine Corps Roundtable was titled Expeditionary Warfare Roundtable. Participants included representatives from the following organizations:

All Program Managers (PMs) from MARCORSYSCOM
All Divisions of MCCDC
Marine Forces Atlantic
Marine Forces Pacific
Headquarters, Marine Corps (P&R, PP&O, LP, C4I)
OPNAV (N81, N85, N91)
ONR (Code 32, OOMC)
Program Executive Office, Mine Warfare

The Science and Technology (S&T) Roundtable is a two stage process designed by OPNAV (OP-91). Stage I is Roundtable I. It's basic output is a prioritized listing of capabilities and functions arranged into "quartiles" wherein the items in the top quartile (or quarter) are deemed more important than those in the lower or fourth quartile. Figures B-1 through B-5 depict this prioritization of capabilities and functions by Warfighting Imperative. Stage II of the roundtable process is Roundtable II, whose product is a determination by the Office of Naval Research (ONR) of the level of effort that the technology community at large is applying against the capabilities and functions in the quartiles. Basically, this is a matrix which matches

technology efforts against items in the quartiles. When the Marine Corps Expeditionary Warfare Roundtable II results were analyzed, it appeared that there was a lot of technology effort being applied against the items in the quartiles. To determine the effectiveness and applicability of these apparent efforts, a detailed assessment was made by the Amphibious Warfare Technology (AWT) Directorate. The objective of this assessment was to determine whether or not adequate investment was being made toward the solution of deficiencies implied by the items in the Roundtable quartiles.

The Expeditionary Warfare S&T Roundtable assessment process is depicted in Figure B-6 and is described in four steps as follows:

STEP 1

A list of 330 S&T programs were reviewed and placed into one of two groups. Group "A" contained only those programs that the subject matter expert felt could be evaluated against the following criteria:

a. Military capability (Operational Maneuver From the Sea (OMFTS), Mission Needs Statement (MNS), Operational Requirements Document (ORD), Roundtable-1 (RT-1), Non-Acquisition Category (ACAT) Program Definition (NAPDD), Technology Demonstration (TD), and operational utility)

b. Uniqueness (Amphibious operations, expeditionary, littoral)

c. Transition potential (funding sources, milestones scheduled, PM assigned/supporting, jointness)

d. Enabling S&T (support feasibility demonstration, risk reduction, support emerging concepts)

Group "B" contained the remainder of the S&T programs and all 6.1 programs.

STEP 2

The Group "A" list was reviewed and revised to align with appropriate Warfighting Imperatives and to prevent duplication. Then, any "B" list programs that appeared to directly support USMC OMFTS needs were transferred to the "A" list. Next, for Group "A" programs, coordination was conducted with the appropriate Navy, Air Force, National Laboratory, Department of Energy (DOE), Defense Advanced Research Projects Agency (DARPA), or Army point of contact to obtain sufficient program information, and with appropriate PMs for transition information. A scoring sheet was used to assess programs against criteria listed in Step 1.

WARFIGHTING THRUST AREA: Maneuver (Sea base to Objective Maneuver/Mobility)

SUPPORTING REQUIREMENTS:

I

Full recon/neutralization in surf/beach zone
Instride obstacle breaching while under fire
Breaching assets as mobile as force
Neutralization of advanced/hardened mines
Modular weapon/combat support transport
All terrain/weather/environment
Signature reduction
Defensive weapons capability [To FP]
Vehicle structures survivable to blast/kinetic penetration
Non-obtrusive ID (Prevent friendly fire, all echelons) [To C2]

II

Instride gap crossing
Nonmetallic mine detection
High area rate standoff recon
Increased speed/range
Increased platform efficiency
Ability for night/weather/smoke/dust/artificial obscurants [To FP]
Improved lightweight body armor
Security: Improved detection/surveillance [To FP]

III

Off route smart mine clearance
Increased maneuverability
Logistics integration
Optimum speed
Optimum team/squad size
Extend visibility range to match weapon range
Intelligent, autonomous wide area denial system
Lightweight/low heat stress personal CB protection
Immunity to NBC attack

IV

Multilevel security on the battlefield
Rapid obstacle barrier construction
Rapid obstacle barrier construction
Lightweight gamma detector
Remote, instantaneous biological sensor
Standoff chemical detection (10km)
Vehicle collective CB protection (20 persons)
High efficiency, integrated, environment-controlled CB protection
Environmentally harmless CB decontamination
Individual protection against nuclear contam
Hardening electronics against nuclear blast generated EMP
Integrated NBC protection

FIGURE B-1. EXPEDITIONARY WARFARE S&T ROUNDTABLE I - MANEUVER

THIS PAGE INTENTIONALLY LEFT BLANK.

WARFIGHTING THRUST AREA: Firepower

SUPPORTING REQUIREMENTS:

I

Precision location at substantial range from sensors
ID (incl ground/CAS IFF, coop/non-coop AAW IFF)
Integration of all fire
Multiple sensor target processing
Increase range (all weapons)
All environment, quick resp close-air/close-in support
Defensive weapons capability [From Maneuver]
Multi-spectrum C2 detection/location [To C2]
Improved multi-spectrum EA [To C2]
Intrusion in enemy's C2 network [To C2]

II

Real-time target/image processing
VLO air target detection/tracking
Cooperative engagement
Improve queuing of man-portable AAW weapon sys (Sensors only)
Ability to put 1st round on target (meter precision)
Fusion of close combat battlefield sensors
Directed energy weapons (reduce munitions reqs)
Increase shooter mobility
Improved multi-echelon EA compatibility [To C2]
Crowd control device (1,000) people
Nonlethal short-range single encounter weapon
Ability for night/weather/smoke/dust/artificial obscurants
Security: Improved detection/surveillance
Reduction of consumables (Ammo only)

III

Close combat target display/Battle damage assessment
Integration of AAW surv sys with other services' systems
Tactical missile/defense surveillance systems
Adv propulsion/penetration tech (incl adv KE)
Indiv weapons: 0 (10) lighter, incr reliability
AAW weapons control and support systems
Affordability (all weapons)/Easily maintainable
Reduced footprint ashore/Non RF EA (not jamming)
Detect intrusion on C2 networks
Improved electronic CCM (LPI/covert/jam resistant)
Integration with other services/coalition products/Improved LPI detection/location
Wide-area nonchem incapacatants (15 min)/Man-portable, reinforced target/wall breaching mechanism

IV

Electro-optics
Man-portable weapon to defeat main battletank
Counter-countermeasures for anti-armor
Area denial weapons
Insensitivity (all weapons)
Increased shelf life (30 yrs)
Helo-transportable (incl prime mover)
Reduced resources to deliver
Improved reporting

FIGURE B-2. EXPEDITIONARY WARFARE S&T ROUNDTABLE I - FIREPOWER

THIS PAGE INTENTIONALLY LEFT BLANK.

WARFIGHTING THRUST AREA: Combat Service Support (Sea-based/Reduced Footprint)

SUPPORTING REQUIREMENTS:

I

Reduced footprint ashore (tailored presence ashore)/
maintain control of ops
Modeling and Simulation Support
Amphibious lift (design for sea-basing, VX and SBX)
[Supply]
[Maintenance]
[Transportation
[Deliberate engineering]
[Health]
[Services]

II

Optimized mobile electronic power [deleted]
Reduced logistical requirements [deleted]
Aviation supported [deleted]
Reduction of consumables (less ammo)
Embedded self-diagnostics
Disposable technology (replace over repair)
Test and evaluation: virtual prototyping [To T&E]

III

High speed mobility
Adv materials for roads/buildings
Adv expeditionary field fortification
Casualty treatment
Miniaturization
Corrective maintenance (self-correction)
Non-intrusive structural inspection

IV

Casualty evacuation
Temporary hospitalization
Casualty collection
Increased delivery efficiency
Environment independent
Rapid onload/offload
Improved material handling
Insensitive munitions
Nontoxic packaging
Lightweight/stronger/modular packaging
Environmentally friendly materials
Self-testing/calibration
Health maintenance

FIGURE B-3. EXPEDITIONARY WARFARE S&T ROUNDTABLE I - COMBAT SERVICE SUPPORT

THIS PAGE INTENTIONALLY LEFT BLANK..

WARFIGHTING THRUST AREA: Command and Control

SUPPORTING REQUIREMENTS:

I

- Comms: Secure, covert, high speed (incl imagery), worldwide
- MAGTF integrated to all echelons
- Merged M&S and C2 systems
- Decision support system: (Distributed/networked for combat ops)
- Shared appropriate situational awareness
- Fused intel info at higher levels
- Non-obtrusive ID (prevent friendly fire (all echelons) [From Maneuver]
- The individual Marine/combat vehicle tracking instrumentation
- Mult-spectrum C2 detection/location [From FP]
- Improved multi-spectrum EA [From FP]
- Intrusion in enemy's C2 network [From FP]
- Improve multi-echelon EA capability [From FP]

II

- Real-time high data rate intel processing/analysis tailored to user
- Real-time distributed access to National Resources
- Recon in support of target acquisition
- Intel processing/analysis transparent to user
- Battlefield 3D visualization systems
- Land/Sea preview/rehearsal, all levels (the individual Marine to MEF) within 48h of tasking
- Conduct mission planning in distributed environ

III

- Special operations
- Multi-modal distributed battlefield sensors

IV

- One meter position/location accuracy
- Convert counter intelligence
- Improve quality/quantity of HUMINT
- Low cost position/condition reporting system for individuals
- Real-time access to dynamic terrain data base

FIGURE B-4. EXPEDITIONARY WARFARE S&T ROUNDTABLE I - COMMAND AND CONTROL

THIS PAGE INTENTIONALLY LEFT BLANK.

WARFIGHTING THRUST AREA: Training and Education

SUPPORTING REQUIREMENTS:

I

Interoperable, distributed, embedded for all combat systems
Increased realism/availabilty in deployed/garrison environment
Decision-making training

II

Test and evaluation: virtual prototyping [From CSS]

III

Make machines/systems easier to learn
Manpower management

IV

Improve teaching methods
Increased education availability

FIGURE B-5. EXPEDITIONARY WARFARE S&T ROUNDTABLE I - TRAINING AND EDUCATION

THIS PAGE INTENTIONALLY LEFT BLANK.

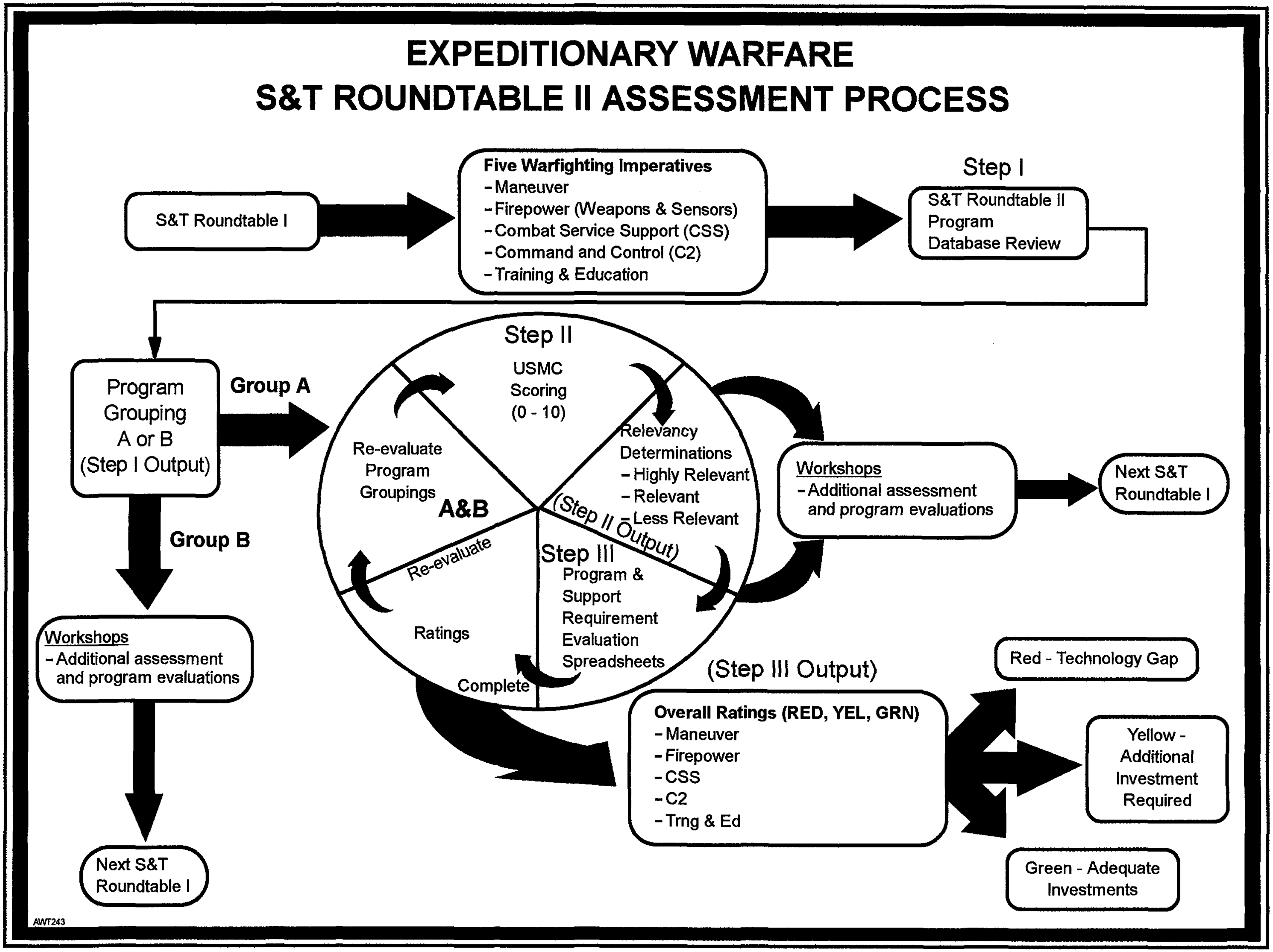


FIGURE B-6. EXPEDITIONARY WARFARE S&T ROUNDTABLE II ASSESSMENT PROCESS

THIS PAGE INTENTIONALLY LEFT BLANK.

STEP 3

MCCDC participated in a joint assessment. First, based upon scoring in Step 2, programs were ranked as: Group "A" (highly relevant, relevant, less relevant) or Group "B" (all other programs). Second, spreadsheets were built and program support requirements evaluated. Third, program groupings "A" and "B" were re-evaluated. Fourth, Step 3 output was briefed to MCCDC and any necessary adjustments were made. Overall ratings (Red, Yellow, or Green) were assigned. Figure B-7 is a sample of this output.

STEP 4

Final S&T assessments were briefed to MARCORSYSCOM and CG MCCDC in anticipation of an out-brief to the Strategic Vision Selection Authority (SVSA).

Figure B-8 summarizes the overall Marine Corps S&T program and the relative position in the Department of Defense (DoD) fabric. The total investment by DoD component is the left vertical axis arrayed against the horizontal axis that represents the five Warfighting Imperatives broken down into the top two quartiles of the roundtable. The right vertical axis depicts how the total DoD component investment is divided among the imperatives above it. Along the bottom, total dollars invested by quartile/by imperative is shown along with a color-coded visual representation of "investment wellness." One would conclude from this that CSS is the most underfunded of all imperatives. Other assessment highlights include:

a. Yellow in Maneuver indicates investment required for in-stride obstacle breaching while under fire, vehicle structures survivable to blast/kinetic penetration, in-stride gap crossing, high-area rate stand-off recon, and improved lightweight body armor.

b. Green in Firepower indicates adequate investment which must be maintained until supporting requirements are met.

c. Red in Combat Service Support reflects a deficiency in technology programs to provide modeling and simulation support, amphibious lift (design for seabasing), reduction of consumables (less ammunition), embedded self diagnostics, and disposable technology.

d. Yellow in Command and Control at this time is because Army classified programs are being reviewed for potential requirements support. The process is ongoing, but we believe there is adequate investment in this area.

e. Yellow in Training and Education indicates investment required in decision-making training and test and evaluation: virtual prototyping.

The Expeditionary Warfare Roundtable developed two architectures; one based on mission areas (MA) and supporting functions for the time frame of 7-20 years and one based on capabilities and supporting functions for the time frame 25+ years. The 7-20 years analysis was

based on the standard 20 MAs for which the MCCDC conducts regular analyses. The 25+ years analysis was based on a proposal by the Deputy CG MCCDC in which seven specific capabilities were articulated. In both cases, 7-20 years and 25+ year time frames, MAs and capabilities were prioritized into quartiles both to facilitate analysis of the lines of data and to enable decisions that will ultimately define funding and support. Figures B-9 through B-11 illustrate the final quartilization.

Spreadsheet Example

EXPEDITIONARY WARFARE S&T ROUNDTABLE MATRIX

			SUPPORTING REQUIREMENTS				
			QUARTILE I				
			A1	A2	B	C	D
NO.	I. MANEUVER IMPERATIVE	ORIG. DATA BASE	Full recon in surf/beach zone	Full neutralization in surf/beach zone	Instride obstacle breaching while under fire	Breaching assets as mobile force	Neutralization of advanced/hardened mines
	OVERALL RATING:		Y	G	R	Y	G
	Highly Relevant:						
1	Explosive Neutralization	42		x		x	x
2	Joint Countermine ACTD	52		x		x	x
3	MCM Mining and Special Warfare	64		x			x
4	Naval Special Warfare	71	x	x			
5	Surf Zone Technology	93		x	x		x
6	COBRA	209	x				
7	Distributed Explosive Technology	215		x			x
8	JAMC	223		x			x
9	Mine Detection Technology	229	x				
10	ORSMC	230				x	x

AWT243

FIGURE B-7. SPREADSHEET EXAMPLE, EXPEDITIONARY WARFARE S&T ROUNDTABLE MATRIX

THIS PAGE INTENTIONALLY LEFT BLANK.

Expeditionary Warfare Science and Technology Investments (Draft) (30 May 96)

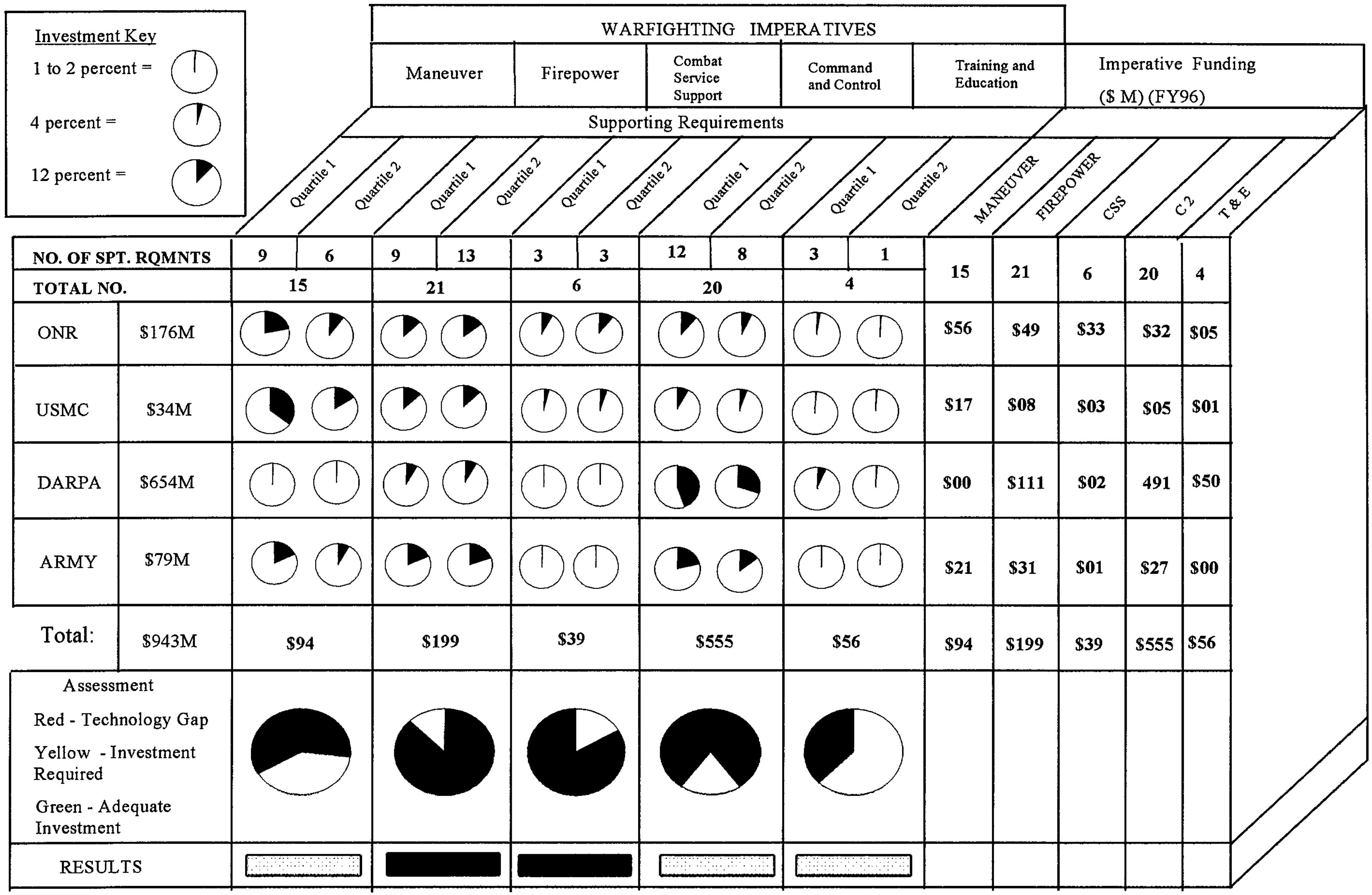


FIGURE B-8. EXPEDITIONARY WARFARE SCIENCE AND TECHNOLOGY INVESTMENTS

THIS PAGE INTENTIONALLY LEFT BLANK.

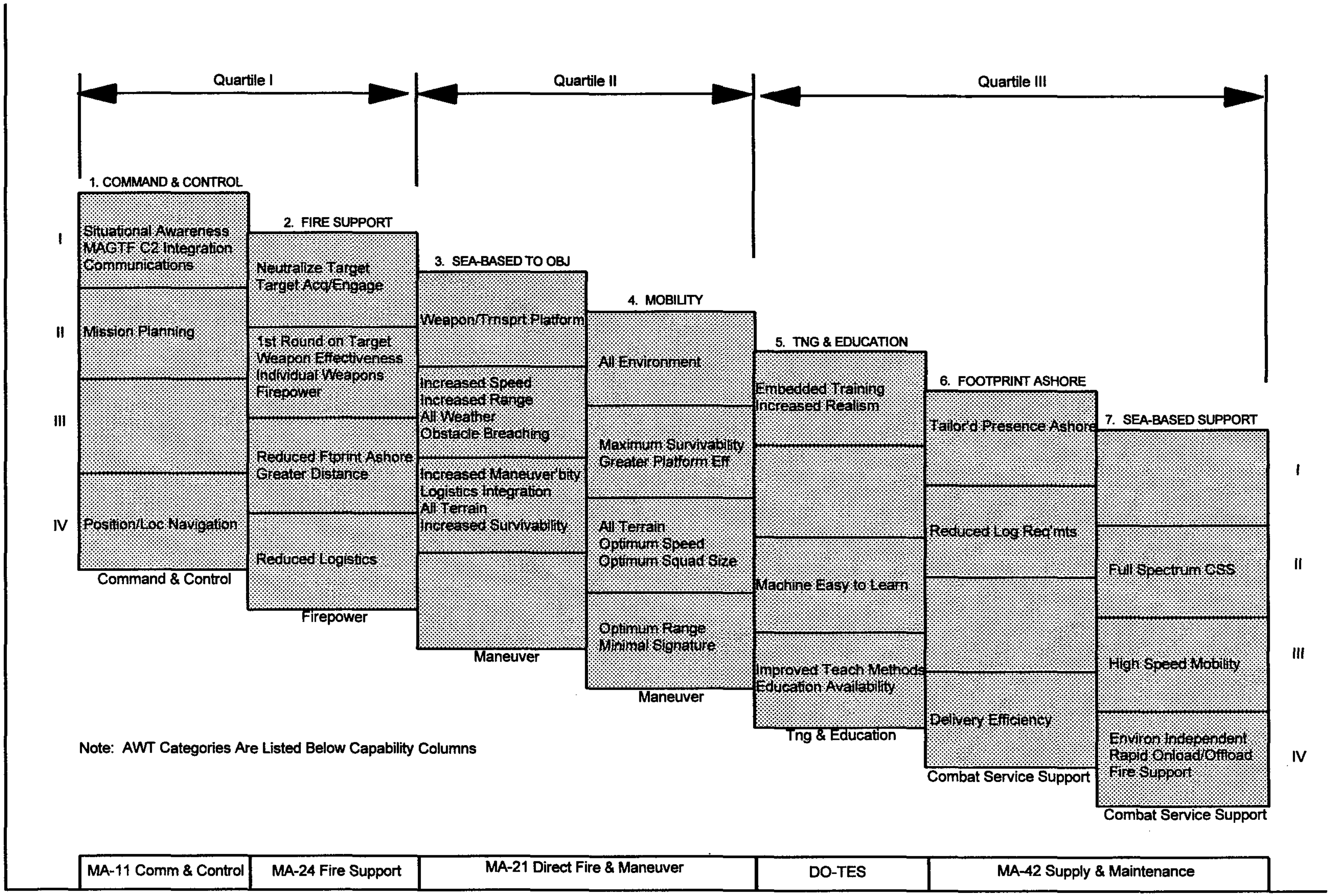


FIGURE B-9. PRIORITIZED CAPABILITIES AND SUPPORTING FUNCTIONS
25+ YEARS

THIS PAGE INTENTIONALLY LEFT BLANK.

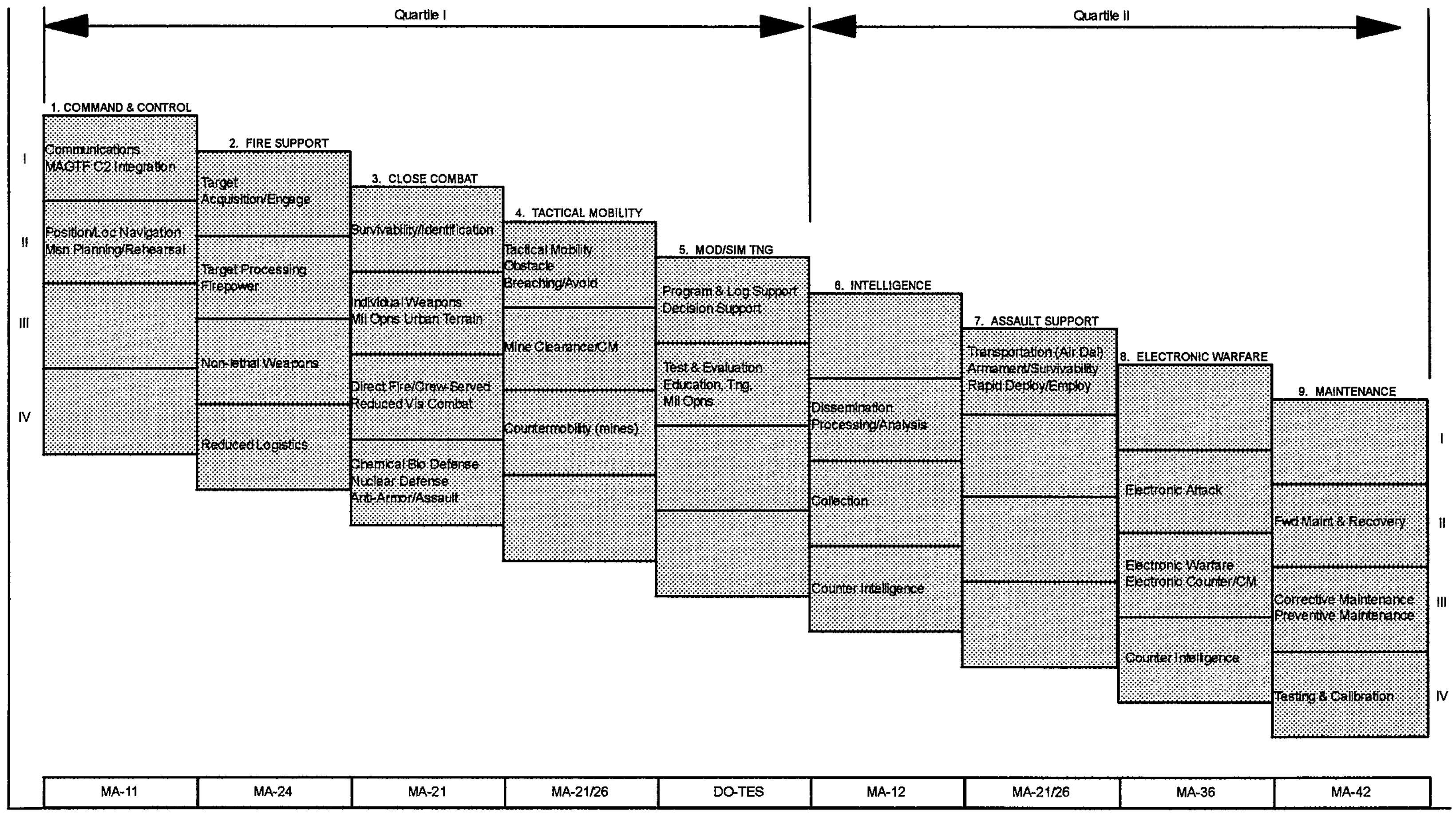


FIGURE B-10. PRIORITIZED MISSION AREAS/SUPPORTING FUNCTIONS
7 TO 20 YEARS

THIS PAGE INTENTIONALLY LEFT BLANK.

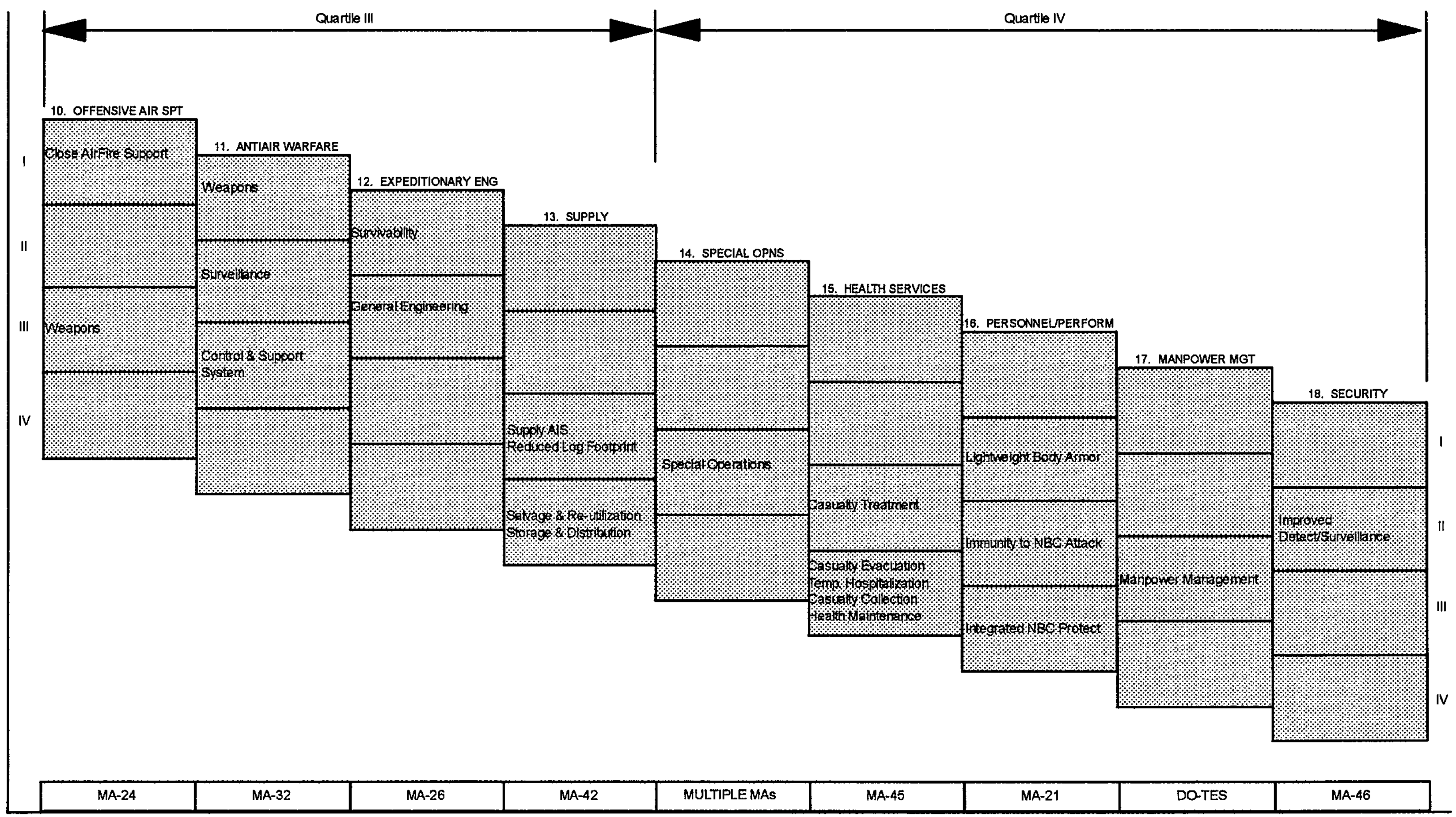


FIGURE B-11. PRIORITIZED MISSION AREAS/SUPPORTING FUNCTIONS
7 TO 20 YEARS

THIS PAGE INTENTIONALLY LEFT BLANK.

ANNEX C

GLOSSARY OF TERMS

A&Q	Alert and Cueing
AAAV	Advanced Amphibious Assault Vehicle
AAFS	Advanced Amphibious Fuel Systems
AAL	Advanced Amphibious Logistics
AAP	Amphibious Assault Planner
AAV	Amphibious Assault Vehicle
AAW	Anti-Air Warfare
ABT	Advanced Breaching Technologies
ACAT	Acquisition Category
ACS	Advanced Countermine System
ACTD	Advanced Concepts Technology Demonstration
AD	Air Defense
ADATS	Air Defense Anti-Tank System
AECSS	Advanced Expeditionary Combat Service Support
AEDT	Articulated Electric Drive Trailer
AFB	Air Force Base
AFC	Advanced Fire Control
AFOE	Assault Follow-on Echelon
AHM	Anti-Helicopter Mine
AHMCM	Anti-Helicopter Mine Countermeasures
AIEWS	Advanced Integrated Electronic Warfare System
AIT	Advanced Identification Techniques
ALGW	Advanced Lightweight Ground Weaponry
ANS	Artificial Neural Systems
APADS	Advanced Palletized Air Delivery System
APS	Advanced Propulsion System
APWSF	Advanced Processors for Weapon Sensor Fusion
AQHUD	Alert and Cueing Head Up Display
ARDEC	Armament Research, Development, and Engineering Center
ARL	Army Research Laboratory
ASAD	Advanced Systems for Air Defense
ASCIET	All Service Combat Identification Evaluation Team
ASDP	Acoustic Sensor Development Platform
ASTAMIDS	Airborne Standoff Mine Field Detection System
ATACMS	Army Tactical Missile System
ATAS	Acoustic Target Acquisition System
ATD	Advanced Technology Development (or Demonstration)
ATHS	Automatic Target Handoff System

ATR	Automatic Target Recognition
AVS	Advanced Visionics System
AW	Amphibious Warfare
AWE	Advanced Warfighting Experiment
AWT	Amphibious Warfare Technology
AZ	Azimuth
BAA	Broad Agency Announcement
BADD	Battlefield Awareness and Data Distribution
BASIS	Battlefield Acoustic Sensor Integration System
BASS	Battlefield Acoustic Sensor System
BC	Battlefield Combat
BCID	Battlefield Combat Identification
BDCM	Brushless Direct Current Motor
BDSD	Battlefield Distributed Simulation Demonstration
BF	Beam Forming
BLRSI	Battle Lab Reconfigurable Simulator Initiative
BMP	Battlefield Marker Panel
BRDEC	Belvoir Research, Development, and Engineering Center
C2	Command and Control
C2W	C2 Warfare
C3	Command, Control and Communication
C4I	Command, Control, Communications, Computers and Intelligence
CARC	Chemical Agent Resistant Coating
CAS	Close Air Support
CASTFOREM	Combined Arms Team Force Model
CATT	Combined Arms Tactical Trainer
CAX	Combined Arms Exercise
CBRS	Concept Based Requirements System
CCH	Computer Controlled Hostiles
CCH/N	Computer Controlled Hostiles/Neutrals
CCIR	Commander's Critical Information Requirements
CCIRS	Commander's Critical Information Requirements System
CCS	Close Combat Surveillance
CCSST	Close Combat Surveillance Sensor Technology
CCTT	Close Combat Tactical Trainer
CDP	Combat Development Process
CDR	Critical Design Review
CECOM	Communication - Electronics Command

GLOSSARY OF TERMS (CONTINUED)

CEIL	Combat Essential Items List
CERMET	Ceramic-metal
CIFS	Close In Fire Support
CLASS	Closed Loop Artillery Simulation System
CLW	Century Land Warrior
CLZ	Craft Landing Zone
COA	Course of Action
COAA	Course of Action Analysis
COASIM	COA Simulator
COBRA	Coastal Battlefield Reconnaissance and Analysis
COC	Combat Operations Center
COC(I)	Combat Operations Center-Interim
COE	Common Operating Environment
COE	Concept of Employment
COMPASS	Common Operational Modeling Planning and Simulation System
CONOPS	Concepts of Operation
COTS	Commercial Off the Shelf
CoVRT	Commander's Visualization Research Tool
CPAC	Corrosion Prevention And Control
CPATR	Concurrent Paradigm-based Automatic Target Recognition
CPFF	Cost Plus Fixed Fee
CPG	Commandant's Planning Guidance
CRT	Cathode Ray Tube
CSS	Coastal Systems Station
CSS	Combat Service Support
CSS	Capability Support System
CSSC2	Combat Service Support Command and Control
CSSCS	Combat Service Support Control System
CSSD	Combat Service Support Detachment
CSSOC	Combat Service Support Operations Center
CTA	Cognitive Task Analysis
CVC	Combat Vehicle Crew
CW	Continuous Wave
DACT	Digital Automated Communications Terminal
DARPA	Defense Advanced Research Projects Agency
DBBL	Dismounted Battlespace Battle Lab
DBC	Digital Battlefield Communication
DBE	Database Engine
DBMS	Database Management System
DCG	Deputy Commanding General

GLOSSARY OF TERMS (CONTINUED)

DEM/VAL	Demonstration and Validation
DET	Distributed Explosive Technology
DEW	Directed Energy Weapon
DF	Direction Finding
DGPS	Differential Global Positioning System
DII	Digital Information Interface
DISA	Defense Information Systems Agency
DLN	Diamond-Like Nanocomposite
DMSO	Defense Modeling and Simulation Office
DNCPPG	Department of Navy Consolidated Planning and Programming Guidance
DOD	Department of Defense
DPG	Defense Planning Guidance
DSP	Digital Signal Processing
DT	Developmental Test
DTED	Digital Terrain Elevation Data
DTP	Developmental Test Plan
DZ	Drop Zones

EADS	Expeditionary Air Defense System
EAGLE I	Enhanced Target Acquisition/Geo-Location Equipment Integration
EARS	Expandable Acoustic Remote Sensors
EBLT	Expeditionary Bulk Liquid Technologies
ECM	Electronic Countermeasures
ECP	Engineering Change Proposal
ECPT	Expeditionary Cargo Packaging Technologies
ECU	Environmental Control Unit
EET	Expeditionary Engineering Technologies
EFP	Explosively Formed Penetrator
EL	Elevation
ELT	Expeditionary Logistics Transporter
ELTV	Expeditionary Logistics Transport Vehicle
EMD	Engineering and Manufacturing Development
EO	Electro-Optic
EOD	Explosive Ordnance Disposal
ERDEC	Edgewood Research, Development, and Engineering Center
ESM	Electronic Support Measures
ESST	Engineering/Supply/Services Technologies
EUT	Early User Test
EV/EHV	Electric Vehicle/Electric Hybrid Vehicle

F..FTS	Forward from the Sea
FA	Fixed Artillery
FAAD	Forward Area Air Defense
FAC	Forward Air Controller
FCT	Foreign Comparative Testing
FCV	Future Combat Vehicle
FEBA	Forward Edge of the Battle Area
FFT	Fast Fourier Transform
FLCV	Future Light Combat Vehicle
FMF	Fleet Marine Force
FMFM	Fleet Marine Force Manual
FO	Forward Observer
FOG-M	Fiber Optic Guided Missile
FONS	Fleet Operational Need Statement
FORSCOM	Forces Command; Army
FOV	Field of View
FPA	Focal Plane Array
FSSG	Force Service Support Group
FSV	Future Scout Vehicle
FW	Fixed Wing
FXXI LW	Force XXI Land Warrior
FY	Fiscal Year
GBDL	Ground Based Data Link
GCCS	Global Command and Control System
GCE	Ground Combat Element
GCSS	Global Combat Service Support
GEN III	Generation III
GEN II	Generation II
GHz	Gigahertz
GOTS	Government Off the Shelf
GPS	Global Positioning System
HCI	Human Computer Interface
HDM	Hand Deployable Marker
HDR	High Data Rate
HMD	Helmet Mounted Display
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
HOTAS	Hands-On-Throttle-And-Stick
HP	Hewlett Packard

GLOSSARY OF TERMS (CONTINUED)

HQMC	Headquarters Marine Corps
HQUSMC	Headquarters United States Marine Corp
HSLS	Handheld Signal Locating System
HTMMP	Helicopter Transportable Multi-Mission Platform
I/O	Input/Output
IBR	Investment Balance Review
IBV	In the Box Visibility
IC	Integrated Circuit
ICOC	Integrated Combat Operations Center
ID	Identification
IEW	Intelligence and Electronic Warfare
IEWD	Intelligence and Electronic Warfare Directorate
IFCS	Intelligent Fire Control Sensors
IFF	Identification Friend or Foe
IFSAS	Initial Fire Support Automation System
ILS	Integrated Logistics Support
IMF	Intelligent Mine Field
IMINT	Imagery Intelligence
IMU	Inertial Measurement Unit
IOC	Initial Operational Capability
IPL	Integrated Priority Lists
IPPD	Integrated Product/Process Development
IPR	In-Progress Reviews
IPT	Integrated Product Teams
IPV	In Process Visibility
IR	Infrared
ISO	International Standards Organization
ITV	In-Transit-Visibility
IUGS	Improved UGS
IW	Information Warfare
JAMC	Joint Amphibious Mine Countermeasures
JANUS	Force model; LLNL
JEPTP	Joint Electric Propulsion Technology Program
JHU/APL	Johns Hopkins University/Applied Physics Laboratory
JIEMD	Joint Integrated Electric Mobility Demonstrations
JMA/SA	Joint Mission Area / Support Area
JMASS	Joint Material Analysis Simulation System
JMAT	Joint Services Medium Caliber Automatic Cannon Technology

JMDT	Joint Mine Detection Technology
Joint M&S	Joint Modeling and Simulation
JORD	Joint Operational Requirements Document
JPO	Joint Project Office
JSIMS	Joint Simulation System
JSSAP	Joint Services Small Arms Program
JSZMC	Joint Surf Zone Mine Countermeasures
JT	Joint
JTC	Joint Tactical Communication
JTEV	Joint Tactical Electric Vehicle
JTIFF	Joint IFF
JWARS	Joint Warfare Analysis System
JWCA	Joint Warfighting Capability Area
KELT	Korean-English Language Translator
LAI	Light Armored Infantry
LAN	Local Area Network
LARC	Lighter Amphibious Resupply Cargo
LAV	Light Armored Vehicle
LCAC	Landing Craft Air Cushion
LCCT	Logistics Command and Control Technologies
LCD	Liquid Crystal Display
LCM	Landing Craft Mechanized
LCTF	Liquid Crystal Tunable Filters
LCU	Landing Craft Utility
LDR	Low Data Rate
LLNL	Lawrence Livermore National Laboratory
LLTV	Low-level Light Television
LNS	Land Navigation System
LOA	Letter of Agreement
LOB	Line of Bearing
LOGAIS	Logistics Automated Information Systems
LOGMARS	Logistics Marking and Reading System
LOS	Line of Sight
LPD	Landing Platform Dock
LPD	Low Probability of Detection
LPI	Low Probability of Interception
LRIP	Low Rate Initial Production
LST	Landing Ship Tank

GLOSSARY OF TERMS (CONTINUED)

LSV	Light Strike Vehicle
LUT	Limited User Testing
LVS	Logistics Vehicle System
LW	Land Warrior
LZ	Landing Zones

M&S	Modeling and Simulation
MA	Mission Areas
MAA	Mission Area Analysis
MAFSS	Mobile Automated Fire Support System
MAGTF	Marine Air-Ground Task Force
MAL	MAGTF Allowance List
MANPADS	Man Portable Air Defense System
MARCORSYSCOM	Marine Corps Systems Command
MARFOR	Marine Forces
MARFORLANT	Marine Forces; Atlantic
MARFORPAC	Marine Forces; Pacific
MASTS	Modeling and Simulation for Targeting Sensors
MBps	Megabytes-per-second
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCCDC	Marine Corps Combat Development Command
MCD	Mine, Countermine, and Demolition
MCLLS	Marine Corps Lessons Learned System
MCM	Mine Countermeasures
MCMIA	Mine Countermeasures Integration and Automation
MCMP	Marine Corps Master Plan
MCTSSA	Marine Corps Tactical Systems Support Activity
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MHz	Megahertz
MICSS	MAGTF Individual Combat Simulation System
MICOM	Missile Command
MIST	Minefield Image Synthesis Tool
MITLA	Micro-circuit Technology in Logistics Applications
MITRE	Massachusetts Institute of Technology Research and Engineering
MMW	Millimeter Wave
MNS	Mission Need Statement
MOA	Memorandum of Agreement
MOBA	Military Operations in Built-up Areas
MODSAF	Modular Semi-Automated Forces

GLOSSARY OF TERMS (CONTINUED)

MOU	Memorandum of Understanding
MOUT	Military Operations in Urbanized Terrain
MPF	Maritime Prepositioning Force
MS	Microsoft
MSBL	MAGTF C4I Software Baseline
MSSG	MEU Service Support Group
MTS	Marine Tactical System
MVDR	Minimum Variance Distortionless Response
NAPDD	Non-ACAT Program Definition Document
NATC	Nevada Automotive Test Center
NAWCTSD	Naval Air Warfare Center Training Services Division
NCCOSC	Naval Command and Control and Ocean Surveillance Center
NCTR	Non-Cooperative Target Recognition
NDI	Non-Developmental Item
NFESC	Naval Facilities Engineering Service Center
NIDL	National Information Display Laboratory
nm	Nanometer
NMS	National Military Strategy
NRaD	NCCOSC Research and Development Division
NRDEC	Natick Research, Development, and Engineering Center
NSFS	Naval Surface Fire Support
NSS	Naval Simulation System
NSS	National Security Strategy
NSWC	Naval Surface Warfare Center
NSWCDD	Naval Surface Warfare Center Dahlgren Division
NTC	National Training Center
NTCSS	Naval Tactical Command Support System
NTDR	Near Term Digital Radio
NVG	Night Vision Goggles
OEO	Other Expeditionary Operations
OMFTS	Operational Maneuver from the Sea
ONR	Office of Naval Research
OODA	Observation-Orientation-Decision-Action
OPNAV	Office of the Chief of Naval Operations
ORD	Operational Requirements Document
ORSM	Off-Route Smart Mine
ORSMC	Off-Route Smart Mine Clearance
OSD	Office of the Secretary of Defense

GLOSSARY OF TERMS (CONTINUED)

OT	Operational Testing
OTH	Over The Horizon
OTH COMM	Over-the-horizon Communications
OTM	On-the-move
OTS	Off the Shelf
P^3I	Pre-Planned Product Improvement
PC	Patrol Craft
PC	Personal Computer
PCS	Personal Communication System
PDR	Preliminary Design Review
PE	Program Element
PEI	Principal End Items
PEO	Program Executive Office
PEO MIW	Program Executive Office Mine Warfare
PILLAR	Portable Imaging Lightweight Laser Radar
PM	Program Manager
PM AD	PM for AIR Defense
PM-CBG	PM for Ground Weapons
PM Comm	Program Manager for Communications
PM INTEL	PM for Intelligence Systems
PM-LAV	PM for LAV
PMS	Pedestal Mounted Stinger
POM	Program Objective Memorandum
POP	Proof of Principle
PPBS	Planning, Programming, and Budgeting System
PPQT	Pre-Production Qualification Testing
PPU	Power Production Unit
PR	Program Review
PSAD	Passive Sensor for Air Defense
PSD	Propulsion System Demonstrator
R&D	Research & Development
RADEL	Radio Label
RAM-D	Reliability, Availability, Maintainability-Durability
RDBMS	Relational DBMS
RDEC	Research, Development, and Engineering Center
RDT&E	Research, Development, Test, and Evaluation
REBAR	Reinforcing Bars
RF	Radio Frequency

GLOSSARY OF TERMS (CONTINUED)

RFC	Rapid Follow-on Clearance
RFI	Request for Information
RFID	Radio Frequency Identification
RFP	Request for Proposals
RFPI	Rapid Force Projection Initiative
RIS	Range Instrumentation System
RISC	Reduced Instruction Set Computer
ROC	Required Operational Capability
RREP	Radio Reconnaissance Equipment Program
RRT	Radio Reconnaissance Teams
RRTS	Rapid Request Tracking System
RSTA	Reconnaissance, Surveillance, and Target Acquisition
RSV	Reconnaissance Scout Vehicle
RT	Roundtable
RTLS	Remote Target Location Systems
RTM	Requirements Translation Model
RTT	Radio Tracking Technologies
RTU	Remote Terminal Unit
RW	Rotary Wing
S&T	Science and Technology
SBI	Simulated Biological Intelligence
SBIR	Small Business Innovative Research
SDS	Solution Development System
SGSS	Surrogate Ground Sensor System
SHORAD	Shore-based Air Defense
SIDS	Secondary Imagery Dissemination System
SINCGARS	Single Channel Ground-Air Radio System
SIPE	Soldier Integrated Protective Ensemble
SMAW	Shoulder-launched Multi-purpose Assault Weapon
SMDG	Stand-off Mine Detection, Ground
SOA	Sustained Operations Ashore
SOCOM	Special Operations Command
SOW	Statement of Work
SPAWAR	Space and Naval Warfare Systems Command
SPET-A	Spatial Processing Evaluation Tool for air Acoustics
SPMAGTF	Special Purpose MAGTF
SSMAC	Smart Standoff Mine Active Countermeasures
SST	Seabasing Sustainment Technology
STAG	Smart Tactical Autonomous Guidance
STMP	Science and Technology Master Plan

STRICOM	Simulation, Training, and Instrumentation Command
SVSA	Strategic Vision Selection Authority
SWMCM	Shallow Water Mine Counter-Measures
T/O	Table of Organization
T&E	Test and Evaluation
TAC	Tactical Computer
TACAN	Tactical Air Control and Navigation
TACFIRE	Tactical Fire
TACLOG	Tactical - Logistical
TACOM	Tank and Automotive Command
TAD	Theater Air Defense
TAOC	Tactical Air Operations Center
TARDEC	Tank-Automotive Research, Development, and Engineering Center
TAV	Total Asset Visibility
TD	Technology Demonstration
TEAMS	Technology Evaluation Assessment Modeling and Simulation
TEMP	Test and Evaluation Master Plan
TEVT	Tactical and Electric Vehicle Technology
TFMC	Tunable Filter Multi-spectral Camera
TI	Technical Insertion
TLD	Top Level Demonstration
TOC	Tactical Operations Center
TPP	Technology Program Plan
TRADOC	Training and Doctrine Command; Army
TRAP	Tactical Recovery of Aircraft and Personnel
TRSS	Tactical Remote Sensor System
TTES	Team Target Engagement Simulator
TTO	Tactical Technology Office
UAV	Unmanned Aerial Vehicle
UFL	ULCHI Focus Lens
UGS	Unattended Ground Sensors
USC	United States Code
USMC	United States Marine Corps
UTED	Ultra Wide Band Tactical Electronic Devices
UTO	Unit Task Organization

UV	Ultraviolet
UWB	Ultra Wideband
UXO	Unexploded Ordnance
VLS	Vehicle Landmine Survivability
WAM	Wide Area Mine
WES	Waterway Experiment Station
WIN	Wireless Link Interrogator Network
WP	White Phosphorous
WSMR	White Sands Missile Range
WTI	Weapons and Tactics Instruction

THIS PAGE INTENTIONALLY LEFT BLANK.